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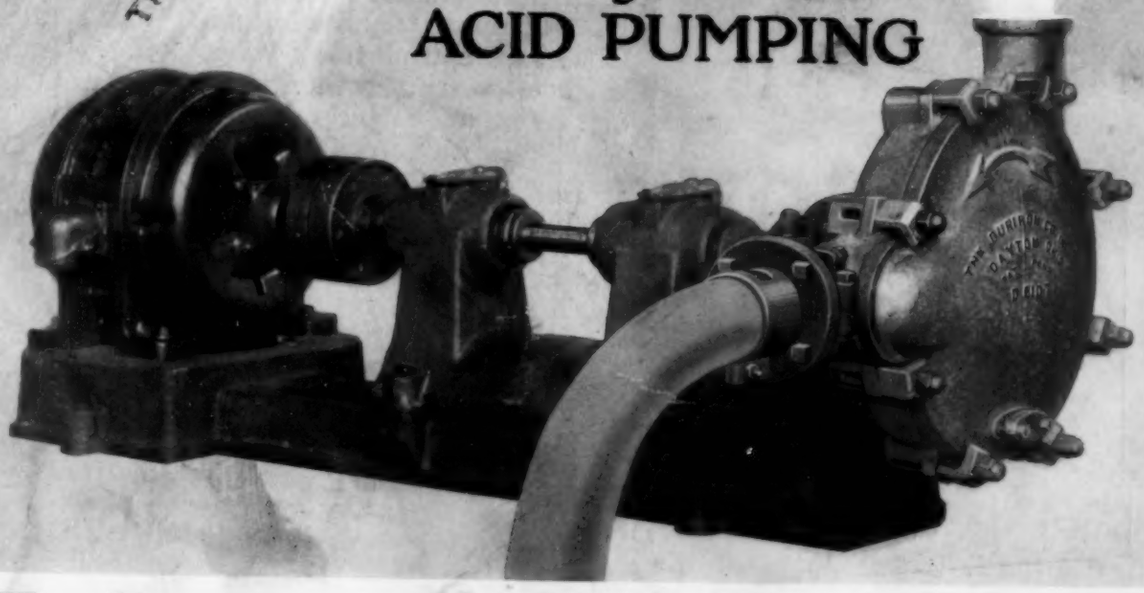

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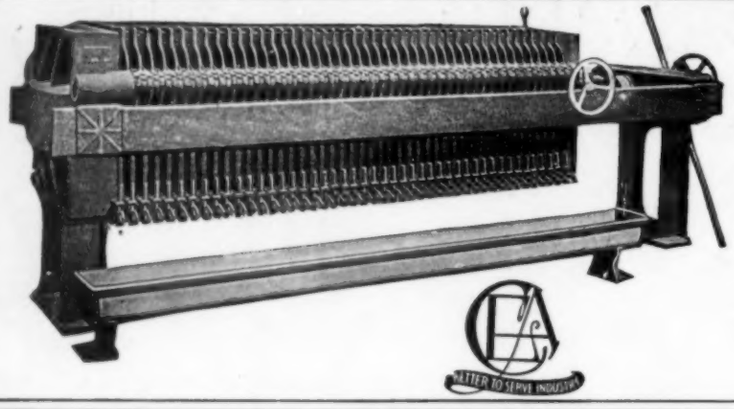

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H. C. PARMELEE, Editor

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Taxation, Bonus Bills and The Cost of Government

WHEN Congress convenes next month it will have to wrestle with the problem of taxation, and it is the hope and expectation of business men that a way will be found to reduce the income tax rate. The hope is justifiable in view of the substantial surplus that is now accumulating in the federal treasury as a result of care and economy in the conduct of the nation's business by the present administration. But a reduction can be realized only if we continue to avoid extravagant expenditures that will not only wipe out the surplus but call for additional taxation.

The mounting cost of government, city, state, and federal, is becoming a matter of great concern to industry. The National Industrial Conference Board has shown that one out of every twelve individuals in this country, over 16 years of age, is on the public pay roll. It has also shown that our cost of government, federal, state and local, is equal to 50 per cent of the wage bill of industry in the United States. In its study of the relation of taxation to national income it has shown that in 1903 taxes for all purposes amounted to only 6.7 per cent of the national income; in 1913, 6.4 per cent. In 1919, however, the rate had practically doubled, being 12.1 per cent, and this was still further increased in 1921 to 16.7 per cent. One-sixth of our national income for taxes! In 1922 there was a recession to 12.1 per cent, but this is still practically double the pre-war rate of 1913. The federal government has shown a steady decrease in taxation since 1919, but local and state governments have regularly increased their respective shares of total taxes.

If the good showing of the federal government is to be continued and translated into a reduction of income tax, Congress must resist the effort that will be made to pass a soldier bonus bill. Not only will the passage of such a bill imperil the plan to reduce taxes but it will undoubtedly necessitate increased taxation. Incidentally, the proposal for a bonus for World War veterans will probably come before Congress in some form or other for the next 50 years. Indeed pensions seem to be the most persistent form of compensation now made by the government. Despite the fact that the pension list for the fiscal year 1922-23 was reduced by 7,260 names, the expenditures increased over $9,000,000. Civil War veterans and their widows are dropping out, but pensioners of the Spanish-American War are increasing. We are still paying pensions to forty-nine soldiers of the Mexican War and to forty widows of the veterans of the War of 1812!

We, in this country, have been acquiring the habit of leaning too heavily on government, which, while it may be a pleasant and agreeable pastime, is certainly an expensive one. We think it is time for everyone to co-operate heartily with the federal government in its determined effort to keep down the cost of the nation's business and to exert all the legitimate influence to prevent such an unwise public expenditure as would result from the passage of a bonus bill. Business has about reached the limit of its capacity to pay taxes.

Compulsory Dosage With Preventive Medicine

DESPITE quibbles as to the relative merits of drugs for specific preventive or curative purposes, there can be no doubt as to the efficacy of some of them if properly administered. Science has demonstrated conclusively that goiter is confined to those whose food supply is deficient in iodine. The authorities at Rochester, N. Y., therefore, have taken definite steps to eradicate the disease within the area supplied by the local waterworks. Early this year 16 lb. of sodium iodide was added daily to the reservoir, the amount of iodine in the water going to consumers being thereby raised to 1 part in 1,000,000,000 parts. This treatment was continued for 2 weeks and is now being repeated. The cost will amount to about $2,000 per annum and the benefit to the community will be incalculable.

There is a humorous aspect to this plan of dosing the community for its own good. Some people are skeptical of the value of scientific research and convinced of the effectiveness of non-material methods of combating disease. But prevention is surely better than cure. If sodium iodide in minute doses prevents the occurrence of goiter, it is obvious that we should benefit from knowledge of the fact.

Science, Fiction and Mere Slovenliness

RECENTLY the publishers of a monthly magazine issued what they featured as a "Scientific Fiction Number." An attempted blending of systematized knowledge with what is opposed to fact and reality was forecast by the title; and we confess to having felt apprehensive as to the result. Our fears were not idle ones. An article that was given especial prominence dealt with "New Apparatus for Microphotography." In this, the repeated reference to microphotographs and microphotography acted as a caustic irritant as soon as it was realized that the author was referring throughout to photomicrographs and photomicrography. A microphotograph is a microscopically small photographic representation of something; a photomicrograph is an enlarged photograph of a microscopic

object; a micrograph is the picture of an object as seen through the microscope.

There is nothing so indicative of the high ideals of the true scientist as his loving care in the proper selection of technical terms. The incursion into the realm of serious literature of half-baked attempts to stimulate the divine curiosity, by the use of the words "science" and "scientific," is responsible for many absurd notions among the uninitiated and the mentally unimaginative. It is painful to be reminded of the slovenliness that characterizes so many of the attempts made nowadays to interest "the man in the street" in scientific progress. As a corrective, it is refreshing to note the well-written and informative items that are being disseminated by Science Service at Washington, the director of which is Dr. Edwin E. Slosson, the versatile and talented author of "Creative Chemistry." The value of his products suggests that there is scope for the publication of an illustrated popular mechano-scientific weekly in the United States; one that would combine good clean journalism with the interest of recent invention and progress, to the exclusion of unscientific sensationalism; a paper in which the findings of scientists and engineers would be so interpreted that any intelligent American could understand and be encouraged in his efforts to get nearer to the fundamental truths underlying the physics, chemistry and mechanics of this fascinating world of ours; a paper to help him to speculate rationally on possible developments in the future.

Fertilizer Selection And Fertilizer Salesmanship

AT THE fertilizer salesmen's conference, Oct. 26, at College Park, Md., Prof. E. C. Auchter presented a discussion of fertilizer requirements for orchard crops which has interest for a far wider audience than the apple grower or the fertilizer salesman in the Maryland territory. Professor Auchter pointed out through a summary of experimental results in apple orchard fertilization that there is practically no evidence from any part of the country to indicate that nitrogen, potash or phosphoric acid is beneficial in cultivated apple orchards on fairly heavy soils. In sod orchards and cultivated orchards on light soils, the fertilizer constituent of value for the trees is the nitrogen, and apparently only the nitrogen. Phosphorus has increased the clovers and grass in the sod orchards. Likewise nitrogen seems to be the only important fertilizer element for peach orchards in general.

There is no more certain way to discredit the fertilizer industry than to sell fertilizers that are not needed. In this Professor Auchter has done the fertilizer industry a real service in offering his mild reproof of the practice of selling mixed fertilizers where nitrogen fertilizers alone were needed.

It is, of course, too much to ask that every fertilizer salesman shall go about the country as a consulting expert, offering exactly that mixture which would be ideal for soil, crop and climate of his customer. But it is not too much to ask that the fertilizer companies instruct their salesmen regarding such important conclusions as these drawn by Professor Auchter, and make sure that they are not overselling their market or urging the purchase of fertilizer constituents of relatively no value. The effort should rather be to induce the farmer to put all of his fertilizer investment into those constituents which he really needs and not all into a general or mixed fertilizer, only part of which is essential under his particular conditions.

Every effort to insure the ultimate user getting full value for his fertilizer investment will mean just that much progress toward stability of the fertilizer trade.

Inevitable Fire Hazard In Chemical Plants

IT IS not surprising that a classification of chemical plant fires shows that about 71 per cent of the total known causes of fire are hazards incident to the industry. What is surprising is that in that branch of the chemical industry producing explosives, where the natural hazard is greatest, a relatively low loss occurs due to fire and explosion. Why is this? Simply because in an explosives plant it is definitely known that extreme care is essential if life and property are to be preserved. As a result of this knowledge no precaution is overlooked, no carelessness tolerated. If the same standards of safety were vigorously adhered to in our other industries, the story of loss by fire and explosion might not be such a sorry one. That the maximum precautions are not taken may be clear from the few instances we shall cite.

A gas light was burning near an alcohol still. The flame of the light met the vapor and both went out. So did the chemist who was working near by. Again fused caustic dropped onto fuel oil, only a few drops it is true, but enough to start a disastrous fire. At another plant producing picric acid a spark from a centrifuge belt ignited the acid. The resulting fire seriously damaged five buildings of the plant. These are but a few of the fires in chemical plants that have been carefully investigated by the National Fire Protection Association. An analysis of 278 such fires occurring through hazards incident to the industry shows that ignition or explosion of the chemical is responsible for 71 fires, while spontaneous ignition accounted for 30 blazes. A total of 31 was caused by the boiling over of chemicals, thus setting fire to surrounding structures. Foreign substances in grinding mills were a particularly fruitful single cause, being known to be responsible for 24 fires, while the ignition of flammable vapor started 20. Overheating in driers and similar apparatus caused 30 of the accidents listed. Minor causes were ignition through spilling of acid, ether, oil, etc., or from the ignition of gas. Fires due to natural causes, so called, which include those due to heating, smoking, power, lighting circuits, spontaneous causes, locomotive sparks, poor fuses, lightning, etc., caused in all 113 fires, thus making a total of 473 tabulated.

Certain interesting and valuable conclusions may be drawn from the study. One fact outstanding is that while 40 per cent of the fires caused losses of more than $1,000, 80 per cent of these were in unsprinklered properties. In other words, there were four times as many highly destructive fires where no precautions had been taken as where the first definite step had been made in preparing for emergency.

The folly of locking the barn door after the horse is stolen is altogether too manifest to bear emphasis. Efficient means for detection and control are no longer unavailable. The expense of establishing safeguards is relatively slight when considered against the possible loss through fire. There is little sense in con-

tinuing our willingness "to take a chance" with a fire risk known to be present, and it is high time that the individual plant sized up its own hazard and prepared to meet it. Let the fire and explosion record of our large modern explosives plants be an example to other chemical engineering plants that are needlessly slack in this regard.

Pressures of Process Steam

AMONG the users of process steam there often seems to be some doubt as to the pressures best suited for their work. The steam will ordinarily be supplied from the boilers at a pressure of about 150 lb. per square inch above atmospheric pressure. The problem is to decide whether to use the steam at this pressure or, if the pressure is reduced, how and how far to reduce it.

There are three factors that will enter into any decision. First, if the heating operation is one that must be accomplished under pressure for the purpose of effecting penetration of the material treated, then pressure is the deciding factor. Again, if the operation requires a certain definite temperature, then steam must be used at the pressure that will give that temperature. The final and by far the most usual case is that in which quantity of heat is the deciding factor.

When that is the case, one often finds steam users generating process steam in low-pressure boilers or reducing with a valve from ordinary boiler pressure to about 30 lb. Common as this practice is, it is far from the best method of operation. The exhaust from the average non-condensing turbine is just as good as any other steam for heating in this third type of operation. In fact, steam at 150 lb. will provide but 3½ per cent more heat than steam at 5 lb. Since this is the case, it is almost always best to get the power which this pressure drop will release if it is accomplished in a turbine and use process steam at the lower pressure.

Copper Oleate And Fishing Nets

EVEN the ancient art of fishing is not proof against invasion by the chemical engineer, bent on effecting economies or reducing waste. A series of tests on the life of linen fishing nets was made by scientists of the U. S. Bureau of Fisheries, with the result that copper oleate has been demonstrated to be remarkably efficient as a preservative. Several factors demanded consideration: Increase in weight must not be prohibitive. In this connection it was shown that proprietary petroleum preservatives overweighted the linen, and that little improvement in this respect was noticeable by the use of bark extract, followed by treatment with copper sulphate. Double treatment in bark extract, followed by immersion in a solution of potassium bichromate, resulted in minimum increase in weight; but the tensile strength of the linen so treated was insufficient to meet demands. The copper oleate method proved simple and effective. A single dipping was sufficient, after which it was demonstrated that flexibility and tensile strength were at a maximum. Recommendations for the use of copper oleate have been made by the bureau, and treatment every 3 or 4 weeks is recommended, the concentration of the solution used depending on the length of the interval between treatments.

Although the metallic preservative will lengthen the life of fishing nets, the bureau has wisely pointed out that its use does not obviate the need for care in the washing and drying of the nets when occasion arises. The spontaneous heating that occurs has usually been attributed to the preservative used; as a matter of fact it results probably from the decomposition of fish oil and animal matter on the surface of the thread, due to the lack of care in cleaning. Thus it is seen that scientific research has demonstrated a common-sense truth as well as provided a means to avoid waste and postpone decay; and yet another industry benefits from the application of trained and systematic curiosity along profitable channels.

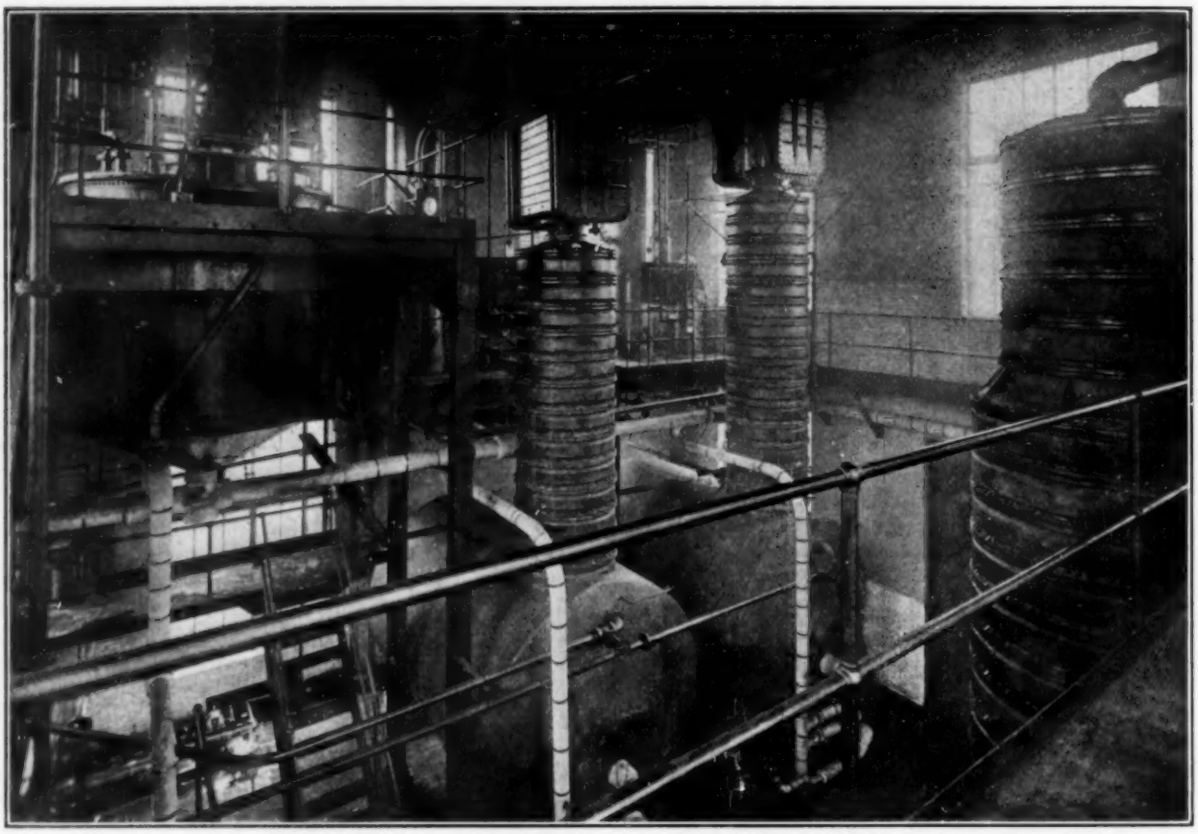
Needless Waste In Distribution

AFTER we had given our card to the young lady at the door and had been told that the younger Mr. A would see us "presently," we sought out a soft spot on the reception room bench and proceeded, soberly, to "cool our heels." By a happy coincidence we discovered at our right a casual acquaintance, a certain Mr. B, who has quite a reputation as a contemporary philosopher but who earns his livelihood by selling chemicals. Having settled a few of the weighty problems of the chemical industry, our conversation turned to our more immediate difficulty, regarding which our friend remarked significantly:

"Things have changed around this place since old man A put George, Jr., in charge of the buying. In the old days I used to be ushered right into the P.A.'s office and if he didn't want to see me he told me so. If he was busy, I waited, but it was never more than a few minutes. Now it's getting so I have to sit around here sometimes for an hour at a time. When I finally do get beyond that door, the chances are that George, Jr.'s, time has been taken up with answering the morning's mail or some other routine business. He's not in a buying mood and I'm told to come back again next week—probably to go through the same procedure. Selling goods to this firm has become a tedious process."

At the time we were inclined to think that our friend was unduly exercised about a situation made necessary by the exigencies of modern business. Since then, however, a little investigation has convinced us that the practice is really one of serious magnitude that entails a great waste in distribution. A comparable waste in production efficiency would not be countenanced by any of our manufacturers. But apparently selling is a different matter and the whim and fancy of the customer must be served. This is done even though it may be necessary to maintain a staff of two or three salesmen to handle a territory that one man could cover adequately were it not for these excessive delays and unbusinesslike methods on the part of the buyer.

The salesman is entitled to better treatment purely as a matter of courtesy. But entirely aside from such considerations the purchaser should not lose sight of the fact that in the last analysis he pays for the cost of selling the goods he buys, and the time wasted by salesmen waiting for a brief interview is an important element of that cost. If the National Association of Purchasing Agents would put this problem up to its members on a dollars-and-cents basis it is certain that most buyers would be willing to contribute their share toward eliminating this source of waste in distribution. But it isn't necessary to wait for that. What is the practice in your own organization?



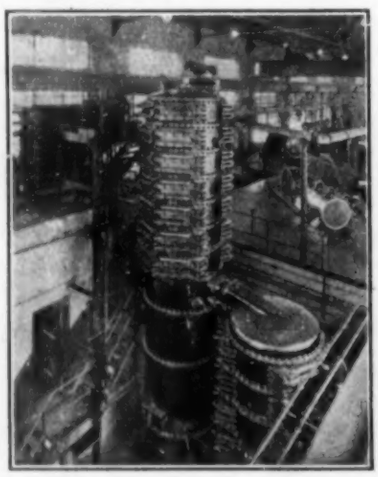
Benzol recovery of the Minnesota By-Product Coke Co. at St. Paul Minn. In the still at the right the wash oil is debenzolized, the product then passing to the crude and pure benzol stills shown in the center of the picture.

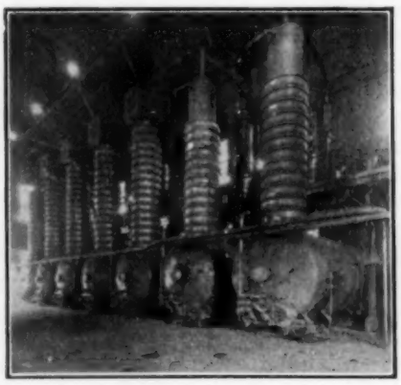
Distillation

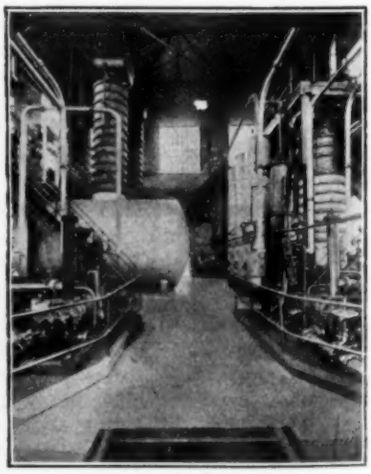
TOO often, perhaps, we are inclined to associate this unit process of chemical engineering with the production of alcohol or petroleum products. We lose sight of the fact that many other of our great industries have distillation problems fully as important and making even greater demands on chemical engineering skill and ingenuity. The byproduct coke industry is an interesting case in point.

If light oils are to be recovered by absorption, there is the problem of efficiently debenzolizing the enriched wash oil. The crude product must then be subjected to fractional distillation and, after agitation with sulphuric acid, refractionated. Still another problem arises in the treatment of gas liquor for the recovery of its ammonia.

The accompanying illustrations, made available through the courtesy of the Koppers Co., will be particularly helpful in visualizing the way in which this industry is solving its distillation problems.







At left ammonia stills of Minnesota By-Product Coke Co. at St. Paul, Minn. Benzol stills at the McKinney Steel Co., Cleveland, O., are shown in the center picture. At right the benzol recovery plant of the Rainey-Wood Coke Co., Swedeland, Pa.

An Industrial Drama

Basic Slag as Phosphate Fertilizer

A Remarkable Story of the Immense Utilization of the Slag From the Basic Bessemer as a Phosphate Fertilizer and of the Changes Made Necessary by Alterations in the Technology of Steel

BY W. H. WAGGAMANN AND H. W. EASTERWOOD
Bureau of Soils, Washington

IN EVERY well-conducted industry it is the aim to utilize to the best advantage the raw materials entering into the manufacture of the main product. Nevertheless, industrial efficiency and future growth have often been sacrificed for immediate profits, and only when the better grades of raw materials become depleted and manufacturing, labor and handling charges begin to mount are new methods sought and economies practiced that will enable the manufacturer to compete with those more fortunately situated than he in regard to their available supplies of natural resources.

These changes in methods of manufacture have in certain instances not only made it possible to utilize low-grade ores formerly considered unfit for use but have actually resulted in the recovery of important byproducts which are an added source of revenue and aid materially in offsetting any additional manufacturing costs.

We have numerous examples where the recovery of valuable byproducts has been effected only through the spur of necessity or after public nuisance legislation had been enacted. Outstanding instances of where these causes contributed largely to the recovery of important byproducts are represented in the production of sulphuric acid from smelter fumes, the recovery of arsenic from the same source and the manufacture of highly phosphatic slag by the basic bessemer process. Basic slag is a useful supplement to steam or degreased bone as a source of available phosphoric acid for fertilizer purposes. It is, however, a product that is produced and used on a far more extensive scale in Europe than in this country, due to the nature of the raw material available for steel manufacture. The annual consumption of basic slag as a phosphate fertilizer is second only to that of acid phosphate, and during the late war certain countries, particularly Germany, had to depend largely on this material to meet its agricultural demand for phosphoric acid.

The latest available statistics showing the annual production of basic slag in the more important European countries are given in Table I.

Basic bessemer slag was first produced in efforts to handle highly phosphatic iron ores which could not be used for the manufacture of the better grades of steel. The presence of phosphorus even in very small quantities imparts to this metal the property known as "cold-shortness" or brittleness, which renders the steel unfit for structural use or for purposes where it is submitted to heavy strains. In 1878, however, two Englishmen, Thomas and Gilchrist, worked out a process for completely removing this element from pig iron so that high-grade steel could be manufactured from these phosphatic ores. Seven or 8 years later it was found that the basic slag obtained as a byproduct in this process was an excellent phosphatic fertilizer.

The equipment used in the basic bessemer process consists of a pear-shaped steel vessel or converter open at the top and provided with a number of inlets in its bottom for the introduction of air under heavy pressure. This vessel may be tilted on a horizontal axis to allow for the introduction of the molten iron and for pouring the slag and steel produced. It is lined with suitable basic materials (dolomite and limestone) which have a strong affinity for phosphoric acid and which form a molten slag with the oxidized silicon and other impurities contained in the metal.

In actual operation the molten iron high in phosphorus is poured into this converter at a temperature of about 1,200 deg. C., lime is added and a heavy blast of preheated air blown up through the metal. The temperature of the mass rises rapidly to above 1,800 deg. C., due to the oxidation of the carbon, silicon and phosphorus. The latter is oxidized to P_2O_5, which in turn is seized by the basic lining of the vessel and converted into complex phosphates. When the "blow" is completed, which is determined by the character of the flame, the converter is tilted and the highly phosphatic slag which floats on the molten steel is run into a slag pot or ladle (to which is added also certain quantities of finely pulverized silica), hauled away, cooled and subsequently broken up, ground and sacked.

While it is highly essential that the silica content of the slag should be kept down during the "blow"

TABLE I—PRODUCTION (IN METRIC TONS) OF BASIC SLAG IN VARIOUS EUROPEAN COUNTRIES FROM 1913 TO 1921 INCLUSIVE*

Country	1913	1914	1915	1916	1917	1918	1919	1920	1921
Germany	2,250,000	2,067,000	1,540,000	1,800,000	1,750,000	1,500,000	700,000	733,000	953,000
Austria-Hungary	50,800	39,900	60,420	85,428	.....	.....	.....	.....	.....
Belgium	655,000	578,000	0	0	0	0	380,000	380,000	325,000
Great Britain	730,000	480,000	495,000	508,000	575,000	556,230	519,135	585,434	210,000
Russia	49,000	60,000	.....	.....	.....	.....	.....	.....	.....
Sweden	18,354	16,688	18,910	13,258	12,173	13,190	11,725	9,390	.....

*Figures taken from Documentary Leaflets of International Institute of Agriculture, July, 1922.

in order to insure the complete elimination of the phosphorus from the steel, it has been repeatedly demonstrated that in slags of equal P_2O_5 content those having the higher percentage of silica usually show a greater availability both by laboratory and field tests. (Wagner, "Dungungsfragen," 1896, Vol. I, p. 28; Maercker, *Deutsche Landw. Presse*, 1895, No. 82, p. 83.) It is therefore customary to add silica to the molten slag when it is poured from the converter and Wagner states that the availability of the P_2O_5 is thus increased from 10 to 30 per cent.

The effective fertilizer ingredient in basic slag is generally believed to be tetra calcium phosphate ($Ca_4P_2O_9$) and in fact the presence of this compound has been determined by a number of investigators. (Hilgenstock, G., *Stahl und Eisen*, 1883; Otto, *Chem. Zeit.*, 1887, vol. 11, p. 255; Wiley and Krug, *Jour. Anal. Chem.*, 1891, vol. 5, p. 685; Fritsch, "Manufacture of Chem. Manures," 1911, pp. 202-4.) But by no means all of the phosphoric acid present in basic slag is in this form, for other crystalline compounds containing P_2O_5 combined with lime and silica have been identified. (Carnot, Richard and Daubre, *Compt. rend.*, 1883, vol. 97, p. 136; Stead and Redsdale, *Trans. Chem. Soc.*, 1887, vol. 51, p. 601; Kroll, *Jour. Iron & Steel Inst.*, 1911, vol. 2, p. 126.)

Further details with regard to the chemical compounds of basic slag are contained in the references noted. (*Jour. Iron & Steel Institute*, 1911, vol. 2, p. 126; *Carnegie Scholorship Memoirs*, Part III, 1920, p. 14, Iron & Steel Institute; Bull 41, Bureau of Soils, U. S. Dept. of Agric., 1907; *Trans.* Faraday Soc., 1920, vol. 16, pt. 2, p. 265.)

Whatever the compounds of phosphorus may be in basic slag (free from fluorine), carefully controlled pot and field experiments have shown that the P_2O_5 contained therein is readily available under soil conditions.

Von Mayer ("Agricultur Chemie," 1902 Vol. II, p. 133) states that the composition of basic bessemer slags falls within the limits given in Table II.

TABLE II—COMPOSITION OF BASIC BESSEMER SLAGS ACCORDING TO VON MAYER

Constituent	Percentage Composition	Constituent	Percentage Composition
P_2O_5	11.0 to 23.0	MnO_2	1.0 to 6.0
SiO_2	3.0 to 13.0	Al_2O_3	0.2 to 3.7
CaO	38.0 to 59.0	MgO	2.0 to 8.0
Fe_2O_3	6.0 to 25.0	S	0.2 to 1.4

TABLE III—RELATION BETWEEN THE SOLUBILITY OF THE P_2O_5 OF BASIC IN 2 PER CENT CITRIC ACID AND ITS AVAILABILITY AS SHOWN BY POT EXPERIMENTS

Brand of Slag Number	Availability of P_2O_5 In 2 Per Cent Citric Acid	In Pot Tests	Brand of Slag Number	Availability of P_2O_5 In 2 Per Cent Citric Acid	In Pot Tests
1	100	100	7	39	40
2	85	80	8	48	38
3	81	72	9	42	38
4	72	72	10	45	31
5	73	66	11	38	30
6	76	63			

Agricultural Availability of Basic Slag

When basic slag was first placed upon the market it was customary to sell it on the basis of its total P_2O_5 content and the degree of fineness to which it was ground. These specifications, however, led to its adulteration with finely ground phosphate rock, which necessitated devising some method by which a mixture of the two materials might be identified. For this purpose Wagner proposed a mixture of dilute ammonium citrate and free citric acid. (*Chem. Zeit.*, 1895, vol. 19, No. 63, p. 1419.) Later the Union of German Experiment Stations at Kiel in September, 1896, adopted the 2 per cent citric acid test and did away with a total P_2O_5 standard and fineness of product. This test, which has also been tentatively adopted in the United States, was applied after checking the solubility of P_2O_5 in this medium with the results obtained by pot experiments. (Official and Tentative Methods of Analysis, 1919, A.O.A.C., p. 14.) In Table III, given by Lindsay (Mass. Exper. Sta., Twenty-second Annual Report, 1910, Part I, p. 79), it will be seen that in the majority of cases results obtained by these two methods checked fairly closely.

According to Kaysser the availability of basic slag is appreciably affected by the rate at which the material is cooled after being tapped from the furnace. (*Chem. Zeit.*, 1920, vol. 44, p. 826.) The P_2O_5 in slags that have been rapidly cooled shows a higher solubility in 2 per cent citric acid than that in slags which are allowed to cool slowly. This greater solubility of the former slags is due, it is claimed, to the formation of less basic phosphates than occur in the slowly cooled slag mass. Fritsch, on the other hand, states that basic slag that is allowed to cool slowly in large blocks is as a rule much more readily ground than that which has been rapidly cooled by pouring it into relatively thin layers. ("Manufacture of Chemical Manures," 1911, p. 212.)

Since basic slag is not readily soluble in water, the distribution of this material in the soil and its effectiveness as a fertilizer are necessarily dependent upon the degree of fineness to which it is ground. On account of its hardness and also because of the metal contained therein machinery of the type usually employed for grinding phosphate rock is not adapted for pulverizing slag. Ball or tube mills therefore are used and a product 90 per cent of which will pass a 100-mesh screen is thus obtained.

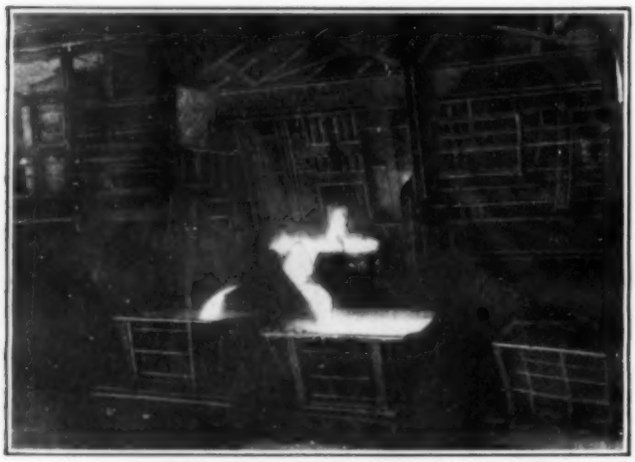


FIG. 1—TAPPING BASIC PHOSPHATIC SLAG FROM A TILTING OPEN-HEARTH FURNACE
(Photograph furnished through the courtesy of the Tennessee Coal, Iron & R.R. Co., Birmingham, Ala.)

Basic Open-Hearth Slag

English agriculturists are much concerned over the tendency to replace the basic bessemer method by the basic open-hearth process, which is more economical but gives a slag much less valuable for fertilizer purposes. The chief aim of the steel manufacturer, how-

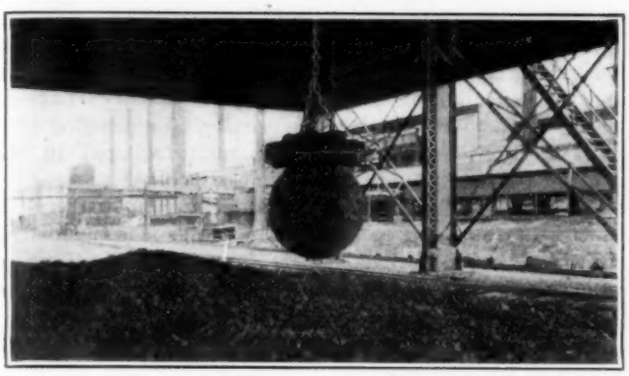


FIG. 2—FIRST STAGE IN CRUSHING BASIC SLAG FOR FERTILIZER PURPOSES

A 15-ton drop ball and magnet for breaking up the blocks of slag and separating particles of steel therefrom. (Photograph furnished through the courtesy of the Tennessee Coal, Iron & R.R. Co., Birmingham, Ala.)

ever, is to produce metal at the lowest possible cost, and the added value of the basic slag produced by the former process is insufficient to offset the saving effected in manufacturing the main product by the latter method.

In the basic open-hearth method iron ore, lime and scrap are charged upon the basic hearth of an arched chamber or furnace heated by oil or producer gas, and the molten iron is poured over these heated materials. A basic slag containing phosphoric acid and most of the other impurities is thus formed and tapped or poured from the furnace when the metal has reached the proper degree of purity.

The main distinctions between the basic bessemer and basic open-hearth processes are that in the former process the oxygen necessary for the purification of the metal is derived entirely from the air that is blown through the molten mass and the high temperature required is derived from the combustion of the silicon, carbon and phosphorus contained in the metal. When using this process, therefore, a pig iron rich in phosphorus is actually desirable in order to insure the necessary high temperature.

In the basic open-hearth process, on the other hand, 70 per cent of the oxygen required for the purification of the metal is derived from the iron ore charged to the furnace, and only 30 per cent from the oxidizing gases in the furnace. Moreover, the heat necessary for the reactions is largely supplied from an outside source. The steel maker, therefore, does not care to use a high-phosphorus pig iron, and this fact, coupled with the greater quantity of slag produced, makes the phosphate content of the slag as a rule considerably lower. Russell states that there are three distinct furnace products now being sold for agricultural purposes in England under the name of basic slag. ("Utilization of Basic Slag," *Trans.* Faraday Society, 1920, vol. 16, pt. 2, p. 263.) They are:

(1) High-grade basic bessemer slag containing 20 per cent of P_2O_5 (85 per cent citric soluble); (2) open-hearth basic slag containing from 7 to 14 per cent P_2O_5 (85 per cent citric soluble); (3) open-hearth basic slag containing from 7 to 10 per cent P_2O_5 (20 per cent citric soluble), in the manufacture of which considerable quantities of fluorspar (CaF_2) have been employed.

In order to remove the last traces of sulphur from the molten metal and to increase the fluidity of the basic slag, the steel manufacturer has in recent years been adding fluorspar (CaF_2) to the charge in the open-hearth furnace. The addition of this mineral decreases greatly the citric solubility and agricultural availability of basic slag due to the formation of compounds analogous to apatite. (Stead, Bainbridge and Jackson, *Trans.* Faraday Society, 1920, vol. 16, pt. 2, p. 302; Bainbridge, *Carnegie Scholarship Memoirs*, 1917, pt. 3, p. 14.) Therefore the average basic open-hearth slag not only contains much smaller percentages of P_2O_5 but its fertilizer value is much less than that produced by the basic bessemer process.

Enrichment of Basic Slags

In order to meet these changing conditions in the manufacture of steel without sacrificing the agricultural availability of basic slag, a number of schemes for the enrichment of this important byproduct of the open-hearth have been suggested.

One of these schemes is to add a certain amount of phosphate rock to the charge on the hearth and thus convert the P_2O_5 of this mineral into an available form. This method, however, has not met with favor and Jones states that the solubility of the added phosphate is not increased unless the charge is allowed to remain in the furnace too long for economical operation. (*Trans.* Faraday Society, 1920, vol. 16, pt. 2, p. 325.) It has also been proposed to add finely ground phosphate rock to the molten slag as the latter is tapped from the furnace, but it is said that this process has also proved unsatisfactory, due perhaps to the difficulty of obtaining a uniform mixture of the slag and rock or to the cooling of the mass before they have had a chance to react. The senior author, however, in a series of experiments on the enrichment of slags obtained both citric soluble phosphoric acid and potash by smelting mixtures of basic open-hearth slag, phosphate rock and feldspar, and it would seem that this method of utilizing the heat energy of molten slags should be eventually worked out. (Bull. 95, Bureau of Soils, U. S. Dept. Agric., 1913.)

Another suggestion that has been made is to add phosphate rock or low-grade phosphatic slag to the charge in the blast furnace in order to produce a pig iron rich in phosphorus which may be subsequently dephosphatized in the steel furnace with the production of a highly phosphatic slag. A modification of this process has been patented by W. R. Walker (U. S.

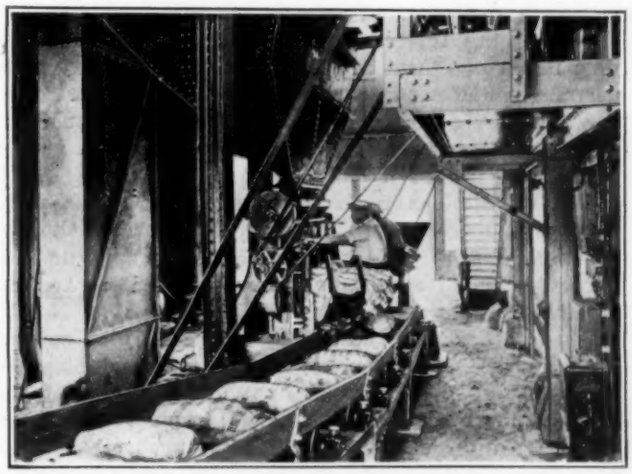


FIG. 3—FINELY GROUND BASIC PHOSPHATE SLAG SACKED AND READY FOR THE MARKET

(Photograph furnished through the courtesy of the Tennessee Coal, Iron & R.R. Co., Birmingham, Ala.)

Pat. 1,299,072, issued in 1919), but it is doubtful if this method could be successfully used except in connection with the basic bessemer process.

It seems to be generally believed, however, that the most practical means of obtaining a highly phosphatic slag when manufacturing steel by the basic open-hearth method is to use a duplex process. In the Bertrand-Thiel process two furnaces are used, in the first of which pig iron without scrap is smelted with basic material. (*Trans.* Faraday Society, 1920, vol. 16, pt. 2, p. 326.) Practically all of the phosphorus and silicon are removed from the metal in this primary furnace and a highly phosphatic slag is obtained. The metal is then transferred to a secondary furnace containing limestone, scrap and fluorspar and the refining of the steel is thus completed.

The American duplex method as described by McCaffrey (*Blast Furnace and Steel Plant*, 1918, vol. 7, p. 287), which is successfully practiced in this country, is almost the reverse of the Bertrand-Thiel process, since the metal is first desiliconized in an acid bessemer converter, the acid slag tapped off and the metal then charged to a basic open-hearth furnace in order to remove the phosphorus. It is understood that the only basic phosphatic slag manufactured in the United States is made by a duplex process.

The use of basic slag in American agriculture is rather limited, and most of that which is consumed is imported from abroad. This is not due to lack of appreciation of the merits of this product, but to the fact that the bulk of the iron ores used for the manufacture of steel are so low in phosphorus that the slags obtained contain only very small percentages of phosphoric acid. In addition to this, our enormous deposits of phosphate rock and large ouput of sulphuric acid have made it possible to obtain soluble phosphates at such a low price that it is difficult for basic slag to compete with them.

Graphs as Time Savers

Many industrial operations require different calculations that have to be made once or several times daily. To increase the efficiency of work the author suggests that all these problems be solved by the aid of graphs, for which he gives some examples from his practice in a paper mill.

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Garden City, L. I., N. Y.

DURING the last few years the practical use of graphical calculation methods has increased considerably in different branches of industry, due to the fact that these methods not only save time but also eliminate many errors and mistakes. It seems advisable that the pulp and paper industry should more generally introduce these methods in practice. The following outlines will show by practical examples how the author used charts for daily service in the mill.

They were worked out when the author had to start a European pulp mill working with the De Vains process; the leading ideas were to simplify the calculating operations so that the different working processes could be checked up regularly and with a minimum of delay. These charts were put into the hands of the foremen of the different departments, thus liberating them completely from calculating work personally. Previous experiences had shown that good workmen were often slow or unreliable calculators, while they learned easily in a short time the purely mechanical use of a chart.

The calculations to be repeated daily result from the working processes, which will be described shortly. The mill had to produce the bleached pulp from esparto grass and eventually from straw. The raw material was digested with a weak solution of NaOH, washed out, treated according to the De Vains patents with hydrate of chlorine, washed again and bleached with a solution of calcium hypochlorite. On a large pulp-drying machine the finished product was dried and cut into sheets. The chemical products, caustic soda and chlorine, were generated by electrolysis of a solution of common salt.

For each digester operation the required volume of soda solution had to be determined; this was perhaps the calculation to be made most frequently. The charge of the digester and the strength of the caustic soda solution varied only slightly from one operation to the next, while the percentage of the NaOH on the raw material had often to be changed according to the composition, the structure and the age of the raw material. Fig. 1 shows the chart worked out for this calculation, while the following example shows how it is to be used. Suppose that 3,400 kg. of raw material shall be digested with 8.5 per cent NaOH, a preliminary titration of the solution having shown its strength to be 95 grams NaOH per liter. Connect point 3,400 on the *Ch* (charge) scale with point 8.5 on the *p* (per-

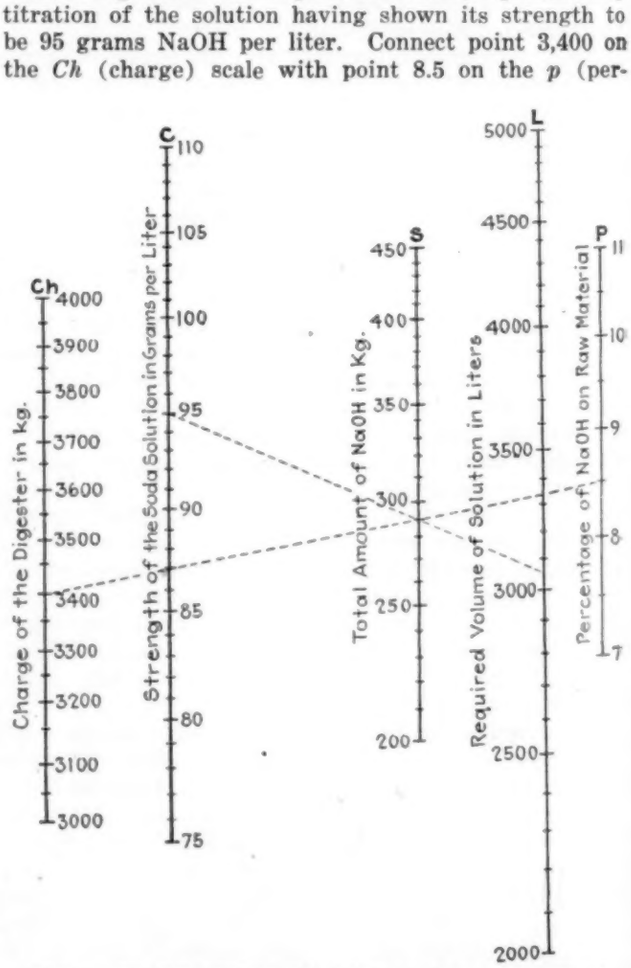


FIG. 1—CHART GIVING VOLUME OF SODA SOLUTION REQUIRED FOR DIGESTER OPERATION

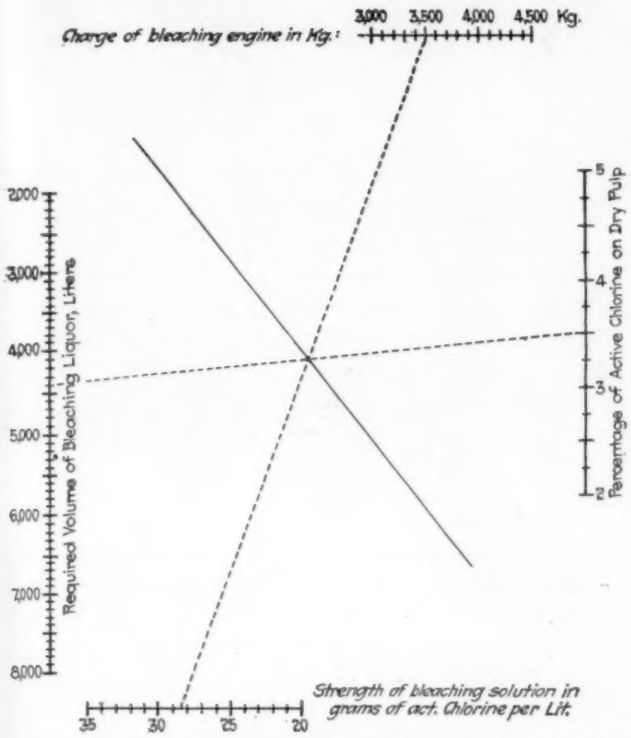


FIG. 2—CHART GIVING VOLUME OF BLEACH LIQUOR REQUIRED FOR BLEACHING OPERATIONS

centage) scale by a straight line and find its intersection point with scale *S*. Through this intersection point and point 95 on *C* (concentration) scale draw another line to the *L* (liter) scale, where the result, 3,050 liters, can be read. The line *S*, as a reference line, could be left without graduation, but it is convenient to fit it with a scale permitting the direct reading of the total amount of NaOH used in the operation. This number is not especially needed by the digester man, but it has to be figured in the daily report of the soda consumption of the digester department. In practical use the connecting lines are not drawn; only the intersection points with scale *S* are marked. The reading is made by using a rule; the determination requires less than a minute and is easily learned by the operators.

How to Figure Bleach Requirement

A similar chart was developed for use on the bleaching engines, where the volume of the calcium hypochlorite solution was to be determined. Under normal conditions the strength of the liquor and the charge of the bleaching engines varied between narrow limits; the percentage of active chlorine on the pulp, however, was variable according to the quality of pulp to be produced and according to the previous treatment of the stuff. The use of this chart is similar to that of the above example; two straight lines have to be drawn, which must cross on the inclined reference line. This chart could be made, too, in parallel co-ordinates the same as Fig. 1; the author chose a chart of the "square type" to give herewith a practical example of this less known, but very useful, system. The dotted lines show that, for instance, the bleaching of 3,500 kg. (air dry) pulp with 3.5 per cent of active chlorine, using a bleaching solution with a strength of 28.5 grams of active chlorine per liter, requires a total amount of 4,300 liters.

A calculation requiring a relatively long time was the daily control of the efficiency of the electrolytic cells. By efficiency is meant the ratio between the effective produced soda and the amount which could be produced theoretically according to Faraday's electrolysis law. It is known that the efficiency depends much upon the condition of the cells, most especially upon that of their diaphragms as well as upon proper cell maintenance. A decrease of the efficiency indicates generally that the diaphragms have begun to lose their permeability and need to be cleaned or that the different regulating valves of the cells have not been properly adjusted. In certain cases considerable differences in the efficiency of the day and night shifts could be found by checking their notations with the chart, Fig. 3. It is worked out for batteries of forty cells, working in normal conditions with 1,100 amp. The amperage and the strength of the soda solution were recorded each half hour, the total amount of liquor was gaged at the end of the shift and the product of volume multiplied by strength—that is, the effective produced NaOH was taken from an auxiliary chart not reproduced here. The example shows that a battery which gave 1,050 kg. of NaOH in 20 hours of service under an average amperage of 1,100 amp. had worked with an efficiency of about 81.3 per cent. These efficiency calculations show clearly the advantage of the charts, because the usual manner of calculating first the theoretical production and then comparing it with the actual is much longer.

Other charts were in constant use in this mill for checking up the chlorinating process and the output of the pulp-drying machines, as well as for shortening certain often repeated calculations in the laboratory. All these charts were more or less similar to the above examples. In each pulp and paper mill and in their auxiliary plants (no matter what process they use) there exist a great number of problems for which graphs of this kind could advantageously be made. For each formula, from the simplest to the most complicated, a properly adapted chart for easy and quick use can be worked out.

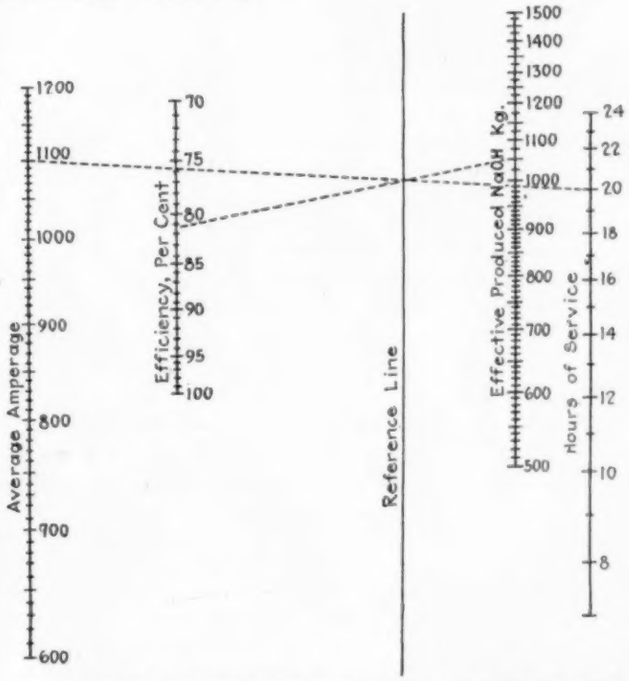


FIG. 3—CHART GIVING EFFICIENCY OF ELECTROLYZER BATTERY OF FORTY CELLS

Hazard of Flammable Dust

Shown in a

Recent Explosion of Aluminum Powder

Electrical Ignition of a Dust-Air Mixture Found Responsible for the Disaster—Expert Investigator Recommends Safety Measures to Prevent Future Accidents

By David J. Price and Robert M. Baker
Bureau of Chemistry, U. S. Department of Agriculture, Washington, D. C.

AN EXPLOSION of aluminum bronze powder in a printing establishment in Richmond, Va., recently caused the death of an employee and wrecked a bronzing machine and its equipment. The explosion originated in an exhaust duct from a cyclone dust collector, and propagated to the vacuum chamber in the bronzing machine, the dust-collecting equipment and the machine being in operation at the time. An investigation indicated that the explosion was not caused by any defect in the machine, but by an accidental electrical ignition of the dust-air mixture.

The company makes a specialty of gold and silver bronze printing on labels for tobacco and cigarette packages, and similar jobs. This work was done in a four-story brick building. The second, third and fourth floors were of heavy frame construction, while the first floor was of concrete. This floor had an average width of 60 ft. and a length of about 90 ft. There was an average of two windows to each bay on all four floors except in the south wall running lengthwise, which was of modern "daylight" construction, with steel sash and wire glass windows.

On the first floor were seven large cylinder presses, three bronzing machines, the office and the heating plant. The wrecked bronzing machine was near the heating plant, which was in one corner of the building. Near this bronzing machine was a combined furnace for melting the type metal and steam table for drying the matrices when in the press.

The composing room and several job presses were on the second floor. The third floor contained chiefly die presses and storage space, while the fourth was used for storing stock and for baling waste paper. A small elevator, as well as a stairway, connected all floors. The roof was of frame construction and practically flat.

The Bronzing Process

The term "bronze" is generally understood to imply an alloy of copper and some other metal which will give a color resembling gold. However, when aluminum is reduced to a powder, and used to resemble a silver coating, it is known as aluminum bronze.

The bronzing process consists of running the sheets into a cylinder press in the usual way, but instead of receiving an impression in ink, the impression is made with sizing. Before the sizing is dry, the sheets are fed into the bronzing machine, where the bronze powder is dusted on automatically and the surplus rubbed off. The sheets are then delivered into a pile the same as in a cylinder press.

Detailed Description of Bronzing Machine

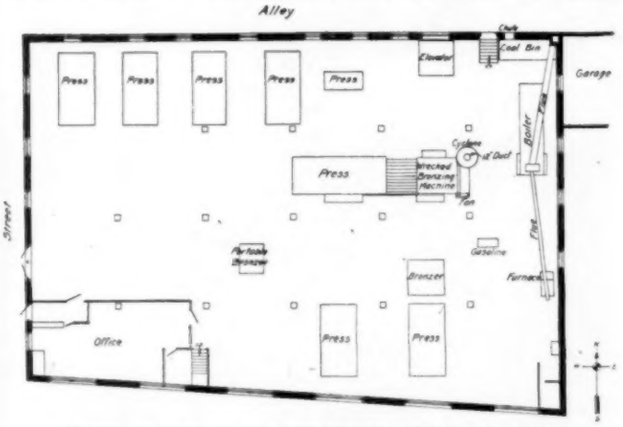
The bronzing machine to which this explosion propagated was driven by a roller chain from a sprocket wheel on a cylinder press. This drive was part of a special conveyor which carried the sheets from the press into the bronzing machine and permitted the machine to work in synchronism with the press. The machine had a capacity of around 1,500 sheets per hour.

The paper was carried through the machine very much the same as in a cylinder press. As the sized sheet entered the machine it was carried along on a large horizontal revolving cylinder, face up. On the top of the machine was a hopper, holding perhaps 30 or 40 lb. of the bronze powder, at the bottom of which was a roll covered with plush which slowly revolved, feeding the bronze powder on to the sheet as it entered the machine. Near this plush feed roll were small pads of beaver fur, staggered in two rows across the cylinder, which revolved flat against the sheet and distributed the bronze to the sizing. The sheet then passed under several soft fluffy rolls, built up of cotton cloth disks on a shaft. The rolls revolved against the

THE WRECKED EXPANSION OR SETTLING CHAMBER ON THE FOURTH FLOOR TO WHICH THE EXPLOSION PROPAGATED

sheet, rubbing the bronze powder into the sizing or brushing off the surplus. The bronze powder then settled into a hopper at the bottom of the machine. The rolls and pads operated under a partial vacuum. The front of the machine was closed by two horizontally hinged steel doors, the upper door having openings which could be closed by a slide. The top and ends of the machine were also inclosed. At one end of the hopper, at the bottom, there was an air intake consisting of holes arranged in a circle which could also be closed by a slide. At the other end of the hopper was an opening 5 in. in diameter protected by a cylindrical screen lying in the bottom of the hopper, into which the inlet of a small exhaust fan was fitted on the outside of the machine. The rotor of the fan was driven by a belt from a motor mounted on top of the machine.

The fan discharged into a 5-in. galvanized iron duct which ran vertically up the side of the machine and over the top into a cyclone dust collector, the dust discharge spout being bolted to the opposite side of the machine from the fan to support the cyclone. This cyclone was about 2½ ft. in diameter and 4 ft. high. The galvanized iron dust discharge spout, 4 in. in diameter, led into a galvanized iron can, which had a double cover to make it dust tight. Into the cover was fitted

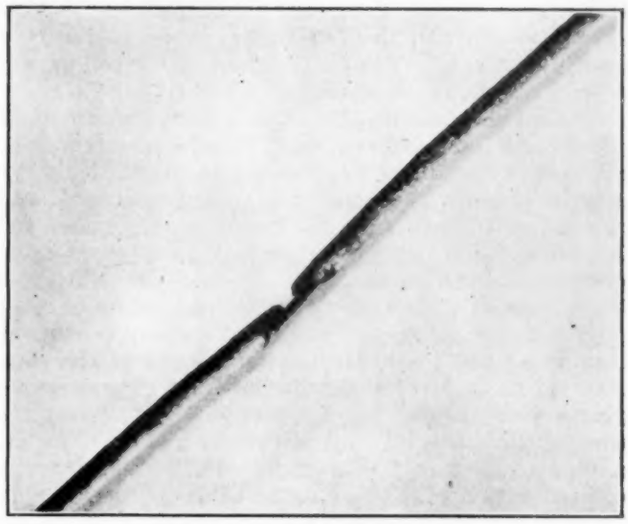


FIRST FLOOR PLAN, SHOWING ARRANGEMENT OF EQUIPMENT

a ¼-in.-mesh galvanized wire cup filled with cotton waste to keep the bronze dust in the can.

When the bronzing machine was installed the cyclone exhausted into the room. The cyclone, however, did not remove all of the bronze powder, and it settled everywhere about the press room. To correct this trouble, a 12-in. galvanized iron duct leading to a large expansion or settling chamber on the fourth floor was placed over the exhaust of the cyclone. Offsets permitted the duct to pass between the floor joints at each floor.

The expansion chamber was about 7½ ft. long, 2½ ft. wide and 3 ft. high. Inside were three canvas curtains or baffles attached to the top of the chamber which were allowed to swing free at the bottom. They were deflected but a few inches during operation of the machine. An elbow in the 12-in. duct permitted the bronze-laden air to enter the chamber in the center of one of the ends near the top. At the opposite end a door was provided for cleaning out the bronze, which was done at frequent intervals. A 14-in. duct led from the top of the chamber in the center near the door up through the roof, and was provided with a cap to keep out the rain.



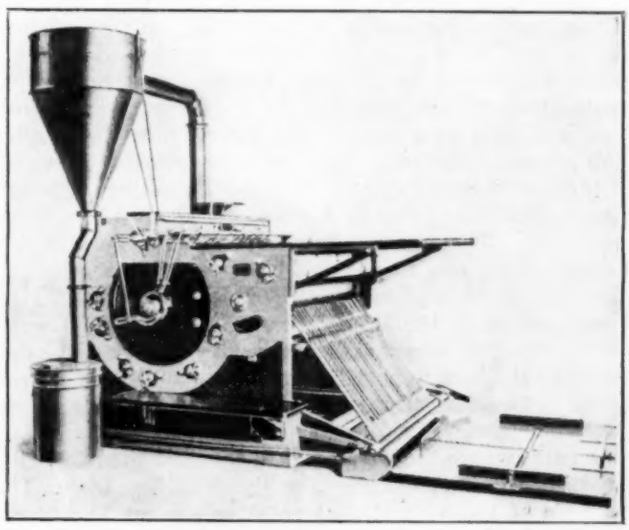
THE 12-IN. COPPER WIRE

This wire, with slow burning insulation, was in contact with the exhaust duct leading from the cyclone dust collector above the bronzing machine to the expansion chamber on the fourth floor. About ⅓ in. of the insulation was burned away.

The explosion propagated throughout the entire bronze-collection system, ripping open the exhaust duct, blowing off the offsets, and setting fire to the second floor. A gray residue coated all equipment near by.

The expansion chamber on the fourth floor was ripped apart and the wrinkled sheets of metal showed effects of intense heat. The floor area to which this chamber was nailed was blackened. The cleaning door was torn off, and the cap over the end of the duct on the roof was blown away. Practically every pane of glass was blown out on all sides and many sashes had to be replaced. The duct was ripped open on the third floor and the offset was blown down. Most of the glass was blown out and a few sashes had to be replaced.

Save for discoloration, the duct seemed practically intact on the second floor. Where the duct came through, the floor caught fire and was charred for a short distance. The windows did not suffer quite as much damage as those on the other floors. One of the employees on this floor when the explosion occurred stated that he was forced to take a few steps backward, and another said the floor seemed to rise and fall in front of him.



BRONZING AND DUSTING MACHINE

The cyclone over the bronzing machine and the 6-in. duct leading from the fan to the cyclone were completely destroyed. The duct leading to the ceiling was blown into flattened sheets of metal.

The cast-iron casing of the fan was broken into many pieces and its rotor was bent. The wooden cover on the hopper containing the bronze powder was split into several pieces. The plush feed roll was charred and the beaver fur pad and cotton rolls were scorched and blackened. The two horizontal steel doors at the front of the machine were blown off, the hinges and fasteners being broken. Some part of the machine was hurled with such terrific force that it bent a heavy iron poker leaning against the boiler and caused two of the stay-bolts in the side of the boiler to leak. There was a pressure of about 5 lb. of steam in the boiler at the time of the explosion. All machinery and other metals within a radius of 20 ft. of the wrecked machine was covered with a gray residue, the oxides of the burning bronze. The machine was blackened and gray both inside and out and showed effects of intense heat. The canvas belts of the conveyor were burned. The ceiling was blackened, although it did not catch on fire except where the duct went through. The insulation on the wires leading to the motor was burned off, as was also the insulation inside the motor. A heavy hasp on the door of a coal chute some distance away was bent nearly straight and broken.

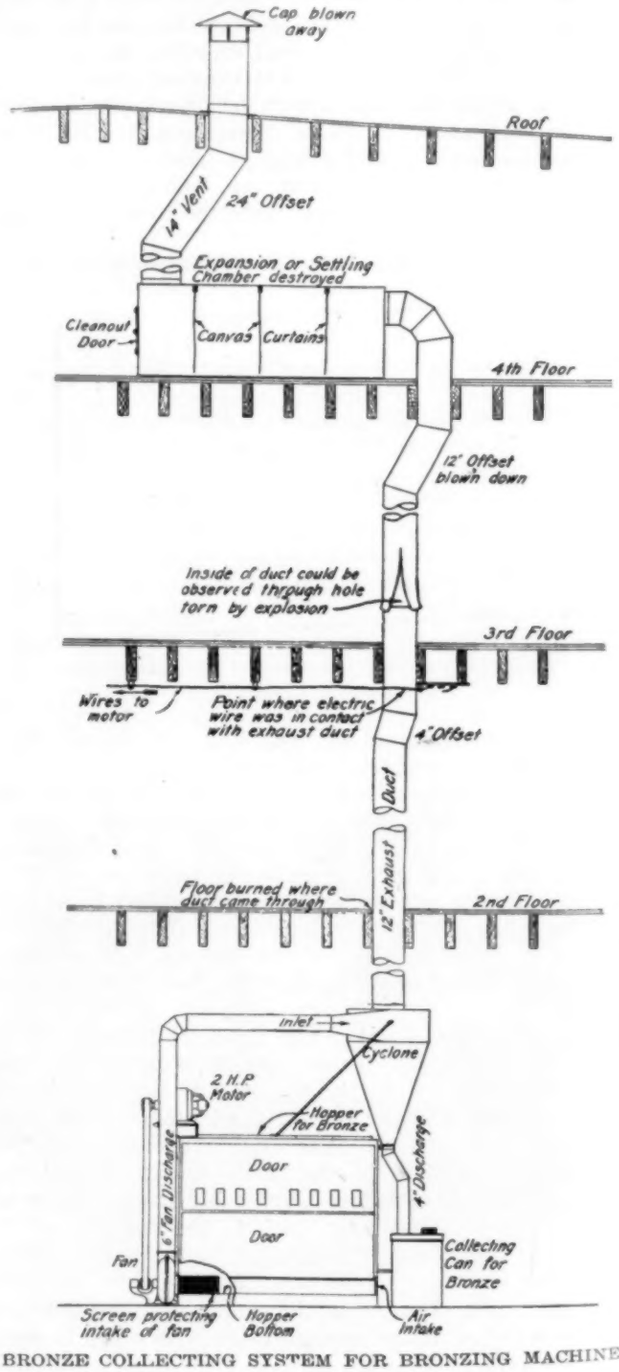
With the exception of one or two panes, all windows on this first floor were blown out. Many sashes had to be replaced. An office partition was moved about a foot, carrying a steam radiator with it. All the glass in another partition was smashed.

Cause of the Explosion

Careful observation of the bronzing machine showed that there had been no defect in the operation of the machine. All bearings in the vacuum chamber had been lubricated and were free to turn. They showed no signs of heating. No repairs were being made. Search was made for a possible metallic ground for static electricity, but none was found. The machine was anchored to the concrete slab which constituted the ground floor, and it is reasonable to assume that enough moisture would be absorbed by the concrete from the earth underneath to carry off any static charges.

In passing between the joists of the third floor the 12-in. duct which led from the exhaust of the cyclone to the roof came in contact with an electric wire. This wire, which was No. 12 gage copper and covered with slow-burning insulation, led to a switch and starting box and then to a motor used for driving the smaller [illegible] presses. The wire was one of the outside wires of a [illegible]-wire system installed along the ceiling, although the middle wire came to a dead end about 12 in. from the duct. The lighting system was connected to one outside wire and to the middle wire. The motor and its equipment was rated at 500 to 550 volts and 30 amperes, while the lamps were 250 volt and 50 watt. When the duct was installed the wire was pushed aside to allow the duct to pass through the floor beside a large beam. The insulation was probably scraped or otherwise damaged when the duct was fitted into place. At the point where the wire touched the duct the insulation was burned from the wire for about half an inch. The outside of the duct at that point was rough and blackened. On lowering an extension light into the duct through a place where it was torn open just above the third floor, a black spot about ¼ in. in diameter with a whitened ring around it could be seen on the inside where the wire had touched the duct. The duct had been in this position for about a year and a half and no trouble had resulted until the explosion occurred.

These observations proved conclusively to the investigator that there had been a short circuit or a ground between the wire and the duct and that an electric arc from at least a 500-volt circuit had heated the point of contact to a high temperature. This was sufficient to ignite the aluminum bronze and cause a very rapid burning of the powder suspended in the air of the duct, resulting in a dust explosion. The explosion propagated upward to the expansion chamber and downward to the machine and its equipment. In tests with aluminum bronze the Bureau of Mines found that the dust laid



BRONZE COLLECTING SYSTEM FOR BRONZING MACHINE

as a train on a soft wooden board could be ignited by short-circuiting a current of electricity through it. A small quantity of aluminum bronze accumulating between the wire and the duct would, as a result of the vibration of the building or duct, gradually work into the damaged insulation, increasing the possibility of an electric arc.

Explosibility Tests of the Powder

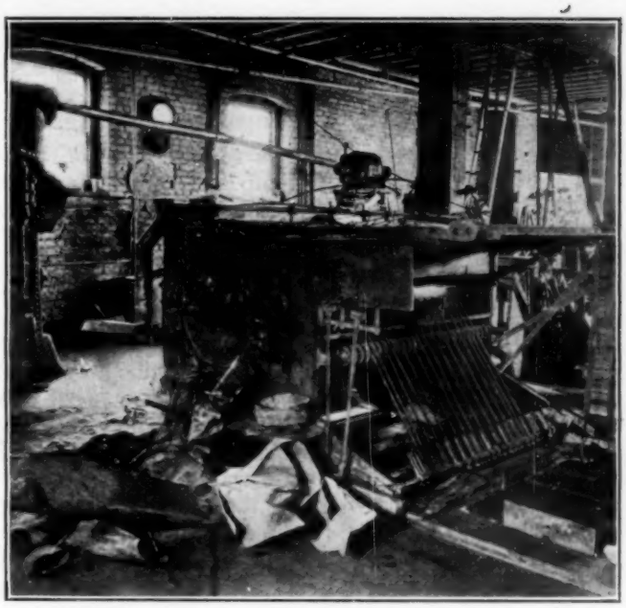
The aluminum bronze, which is an alloy or mixture apparently containing about 90 per cent aluminum, is purchased from a local printing supply house, and is obtained from Germany. Before being used about 50 or 60 lb. is placed in a can and 5 lb. of magnesia is mixed with it. This magnesia powder probably helps to make the bronze brush off much more readily from the sheet, as the aluminum powder is disagreeable and hard to handle and has a great tendency to stick to that part of the sheet which should not be bronzed.

Samples of the aluminum bronze, the magnesia powder and the gold bronze were submitted to the dust explosion laboratory in the Bureau of Chemistry for study and analysis.

The aluminum bronze has a specific gravity of 3.0. It was fine enough to give a persistent dust cloud when thrown into suspension. The ignition temperature at which it will ignite and burn slowly on lying in contact with a hot metal surface is approximately 700 deg. C. The temperature at which a dust cloud will ignite to propagate combustion throughout the cloud was found to be 900 deg. C., at which temperature two trials out of five gave good propagations. The bronze was moderately explosive when a glower at 1,150 deg. C. was used as the ignition source, pressure of 5 lb. per sq.in., 2, 7 and 0 being developed when 50 mg. per liter, or 0.05 oz. per cu.ft., was thrown into suspension. In the four trials the flames observed were respectively blinding, positive, blinding, and a slight flicker. When an induction coil spark was used as a source of ignition, a pressure of 10 lb. per sq.in. was obtained in three trials. The flame in each case was a blinding flash. An idea of the degree of explosibility of the dust can be obtained from the fact that powdered sugar under the same conditions with arc ignition gave 11.3 lb. per sq.in. pressure; starch gave 13.7 lb. per sq.in.; and sulphur, 9.3 lb. per sq.in. Clouds of these dusts are known to explode readily and with violence on contact with a suitable source of ignition.

FRONT VIEW OF THE WRECKED BRONZING MACHINE

Note top of the cyclone dust collector wrapped around pipe near the ceiling. This view shows the cylinder, the beaver fur pads, the charred dusting rolls and the broken fan at the base of the machine.



ANOTHER VIEW OF THE WRECKED BRONZING MACHINE

The remains of the cyclone dust collector and the duct are on the floor. The operator of the machine, who died from injuries, was standing on the small platform beside the machine.

Concentrations of dust lower than 50 mg. per liter ignited with difficulty or not at all when the glower ignition was used, but very readily when an arc ignition was tried. This indicates that the aluminum bronze is as explosive as the more explosive of the industrial dusts when the temperature of the ignition is high. It can be seen that an ignition once started at about 700 deg. C. may increase in temperature to a point easily dangerous in a cloud of aluminum bronze.

The magnesia powder, a carbonate of magnesium, is lighter than the aluminum bronze, having a specific gravity of 2.1. It is ordinarily an inert dust and has the property of inhibiting the combustion in an explosion similar to that of a rock dust or ash. The addition of 10 per cent of the magnesia to the aluminum bronze gave a pressure of 5 lb. per sq.in. in three trials, as compared with 10 lb. per sq.in. for the bronze itself, showing that magnesia apparently exerts an influence in cutting down explosibility.

The gold bronze is an alloy or mixture of copper and some other metal. It is heavier than the aluminum bronze, having a specific gravity of 6 and is practically non-explosive. A shower of ignited particles arose from the glower at 1,200 deg. C., giving a maximum

combustion pressure of 1.5 lb. per sq.in. in three trials. The apparatus used for explosibility tests was the standard Clement-Frazer laboratory apparatus consisting of a heavy glass bomb of known capacity in which is suspended either a glower, the heat of which can be measured, or wire terminals for arc ignition. The measured dust is placed in a cup and thrown into suspension by compressed air. An indicator at the top records the pressures developed.

Extinguishing Aluminum Dust Fires

Alan Leighton, physical chemist, Bureau of Animal Industry, U. S. Department of Agriculture, states that aluminum dust fires are difficult to extinguish, owing to the reducing action of the hot aluminum on most substances used in the ordinary chemical extinguisher and to the chemical action between powdered aluminum and water. When sodium carbonate was applied to red hot aluminum, to the amazement of the investigators, an explosion usually resulted. It was found that red hot aluminum would reduce the carbon dioxide of the carbonate and that it would also reduce gaseous carbon dioxide. This would indicate that under certain conditions the addition of magnesia to aluminum bronze would perhaps aid in combustion.

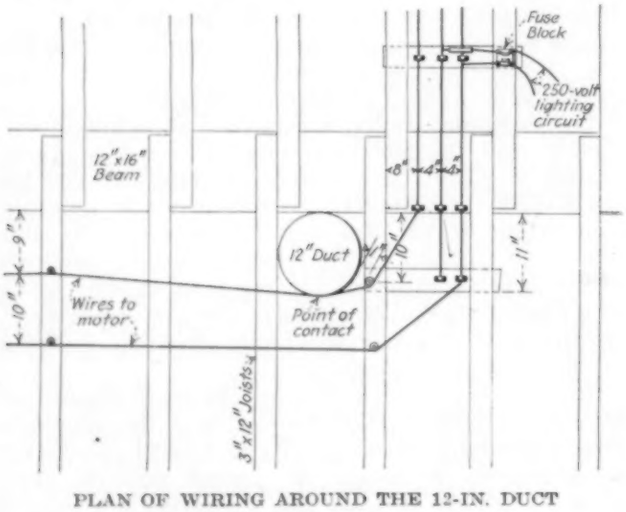
Some experiments were conducted in the use of Foamite-Firefoam for extinguishing aluminum dust fires. These experiments were wholly unsuccessful, since both the water and the carbon dioxide were as fuel to the fire. It is also believed that red hot aluminum can reduce carbon tetrachloride. This means that care would have to be used in extinguishing a fire with this material.

Ordinary sodium chloride proved to be a most satisfactory material for use in extinguishing aluminum dust fires. If poured on a pile of red hot aluminum it melts on the surface and forms a thick crust which soon extinguishes the blaze.

Recommendations

Explosions in industrial plants where clouds of aluminum dust are created, as well as laboratory experiments, have proved that this dust is explosive when ignited, and that it must be handled with caution. The fact that aluminum dust is explosive should be brought to the attention of all industries creating or using an aluminum dust.

The dust reclaiming system as installed in this printing plant evidently operates successfully, as it was claimed that very little of the aluminum bronze escaped from the duct on the roof. The cyclone dust collector and expansion chamber, however, should have been installed on the outside of the building, because of the dust explosion hazard, and a future installation of this type has been recommended. All joints in the ducts should be made dust tight.



PLAN OF WIRING AROUND THE 12-IN. DUCT

At certain times of the year when the air is dry there is a possibility of static electricity accumulating on the ducts and the machine. As a precaution, grounding the machine and the ducts was recommended. This can be done by connecting a No. 14 copper wire to a bolt in the frame of the machine, and leading the wire to a water pipe close by and soldering the wire to the pipe. This wire should be protected from injury. The cyclone dust collector should also be connected to a water pipe in the same manner.

A thorough inspection of all electrical equipment by a competent electrician has been recommended, besides the regular inspection by a member of the fire department. Had such an inspection been made before this explosion, no doubt the wire against the metal duct would have been seen and the wiring changed before such an explosion could occur.

Laws of Coal Carbonization

Three extreme views of coal carbonization were pointed out by A. W. Warner at the recent convention of the American Gas Association. The coke oven typifies large-scale high-temperature work with the object of coke quality first and foremost. Low-temperature carbonization strives essentially for high yield of quality oil and tar. Complete gasification seeks a maximum per cent of the original heat as gaseous B.t.u. But in all extremes or any variation among them, there are certain fundamentals which this author defines as follows:

I. If removal of volatile matter from coking coal were the only consideration, the high heats commonly used in carbonization are unnecessary.

II. The condensible hydrocarbons of coal are more valuable as raw products the nearer to their primary state they exist, because no way has been found to convert any but a meager portion of them into permanent gas.

III. The less the cracking and the more the distillation of condensible hydrocarbons occurs the less will be the intensity of heat required to drive off the volatile matter of coal.

IV. The less the heat through which the gases from the non-condensible hydrocarbons must pass in leaving the retort the richer will be the gases and the greater the B.t.u. feet from this source per unit of coal.

V. The closer the ideals of IV are met the greater will be the possible cubic feet of mixed gas of a determined B.t.u. per unit of coal.

In general, therefore, the speaker urged that more thought be given to preventing degradation of raw material to objectionable byproducts. Instead of expending labor in trying to get rid of the products once they are formed, it would be far more profitable to prevent their formation in the first place. To this end, the fundamental laws that determine how coal must be retorted to produce the most valuable sum of products must be studied.

This paper tells how the centrifuge came to be applied to this problem and how the development of the so-called solid discharge and top feed made the process commercially successful. The old cold-settling method rarely yielded more than 10 per cent compared to 85 per cent by this method.

Centrifugal Separation

Wax From Lubricating Oils

By Leo D. Jones
Sharples Specialty Co., Philadelphia, Pa.

THE USE of the centrifuge for dewaxing lubricating oils grew out of the effort to secure better results than had been attained by the common "cold-settling" process. This process was the only known method for dewaxing steam-refined cylinder stock (600 deg. fire test), the product known as "bright stock" being commonly used for building up "pressed"—that is, dewaxed—neutrals of, say, 200 sec. viscosity to a higher value. The process consisted of mixing the cylinder stock with approximately one and one-half times its volume of naphtha, heating to dissolve completely all the oil and wax and then slowly chilling to about 15 deg. F. in large insulated tanks. This caused the wax to precipitate. It was allowed to settle out by gravity. The supernatant liquid was then drawn off and the naphtha distilled off, leaving a still residue of bright stock. The sediment from the settling, of a slushy nature, was withdrawn. After removing the naphtha by distillation, the residue was petrolatum.

At some point in the process, preferably after the dilution but before chilling, the mixture was decolored by percolation through fullers earth.

The finished bright stock produced by this process had a cold test of about 50 deg. F. Efforts to improve this by chilling to a lower temperature resulted in a considerable reduction in yield and increased uncertainty of settling. Even when chilling to 15 deg. F. it was not uncommon to find that after a week's waiting a tank had not settled. It was then necessary to heat and rechill. This uncertainty was a serious problem; in one case a refinery superintendent had men riveters hold pneumatic hammers against the tank for hours, hoping thus to cause agglomeration and settling of the wax. Yields of bright stock above 70 per cent were uncommon.

History of Centrifugal Application

It is not surprising, therefore, that many attempts were made to improve upon the results obtained by cold settling. George H. Taber, vice-president of the Gulf Refining Co., Pittsburgh, Pa., made a number of experiments with cream separators in 1890, but had done nothing more. The only centrifugals available were of the cream separator type. Such separators are not suitable for the separation of two liquids. They serve only to concentrate a dispersed phase of an emulsion into a fraction of the continuous phase, and it is hardly to be expected that they would have handled a liquid and a plastic solid.

It was shortly after putting into general use centrifugal separators employing the principle of hydrostatic balance that P. T. Sharples took up the investigation. He discovered that the wax, as separated by centrifugal force, differed from the slushy liquid separated by gravity. It was a plastic of too high a "yield" value to act freely as a liquid under the forces within the centrifugal rotor. It was only with considerable difficulty and by using a rotor of the hydrostatic balance type that adjustments could be made to give a discharge of wax, and that only for short periods. It was necessary to upset slightly the hydrostatic balance to offset the resistance of the wax to flow, and then a condition of unstable equilibrium was obtained. This was because the resistance of the wax and also its density were not constant, but varied with the time it was exposed to centrifugal force. If, for instance, there was a slight reduction in capacity, this permitted the wax to remain in the rotor longer, with the result that it became more dense and offered more resistance to flow, both of which caused the wax layer to become thicker. Thus the action became cumulative, resulting in overcrowding the rotor with wax.

While the above uncertainty of operation can be minimized by using a centrifugal of much lower centrifugal force, the softer wax obtained and the lower yield of oil make it undesirable.

Solid Discharge

All of this trouble was soon overcome by the invention of the so-called "solid discharge." A stratum of a third liquid substance, heavier than either of the two separated substances, was maintained within the rotor. This served two purposes. One of these was the provision of a frictionless surface on which the wax might float and flow. The second and more important was the provision of a uniform and non-resistant liquid with which to form a hydrostatic balance with the wax-free oil layer in the bowl. The rotor was then adjusted, as if the wax were not there, so as to give a maximum thickness of oil layer without allowing any oil to discharge with the carrier liquid. Any separated wax formed a thin layer between the oil and carrier liquid and soon leaked out with the latter. The operation became entirely independent of the condition of the wax and a stable equilibrium was obtained instead of an unstable one.

Calcium chloride brine refrigerated to the same temperature as the chilled oil was used as a carrier liquid, and fed in such small quantities as to make its presence evident in the wax discharge.

This development of the solid discharge centrifugal rotor with the use of a carrier liquid marked the beginning of the commercial use of the centrifuge in the production of bright stock.

Since this original development an improvement of practical importance has been made in the method of maintaining the stratum of carrier liquid. Formerly it was fed to the rotor with the chilled oil, flowed through the rotor at a very low rate and discharged over the inner edge of a ring on the rotor. The discharge was kept at a minimum. The writer has replaced the feed in contact with the chilled oil by a jet of carrier liquid directed within the above-mentioned ring. This is known as the "top feed." When the rotor is empty, the carrier liquid flows into it downward

Presented at the Tulsa, Okla., meeting of the American Institute of Mining and Metallurgical Engineers, Oct. 11, 1923.

instead of upward, but once the rotor has been filled to the edge of the ring, any further addition pours out over the edge of the ring. This avoids any necessity for refrigeration of the carrier liquid, in consequence of which the economic prohibition upon supplying heat to the wax cover is eliminated, so that the wax may be melted upon its discharge and readily conducted from the centrifuge; also it avoids admixture of the carrier liquid with the chilled oil. This arrangement has eliminated the tendency to produce sometimes a slight cloud in the finished oil and to interfere to a certain extent with wax separation. A higher yield of oil and a better cold test are thus obtained.

Chilling

The effectiveness of the centrifuge in removing the wax from the chilled oil is entirely dependent on the manner in which the diluted oil is chilled. We have found that the most satisfactory method is as follows: A tank provided with brine-circulating coils is used as a container for the oil mixture. The coils extend from top to bottom of the tank and are either grouped at the center of the tank or extend around the wall, leaving the center clear. Either arrangement produces a natural convection current down around the coils and upward through the remaining space.

The oil mixture is heated to about 100 deg. F. until all wax is in solution and all moisture settled out. The mixture must become bright, otherwise a faulty precipitation of wax is likely to occur. The mixture is then transferred to the chilling tank. Brine is circulated through the coils at a temperature not more than 10 deg. F. lower than the oil. This differential is carefully controlled so as to give a chilling rate to the oil of about 3 deg. F. per hour. Such control is easily accomplished as follows: A circulating pump is put in series with the coil in the tank, continuously recirculating the same brine through the coil. A regulated quantity of cold brine from the brine cooler is admitted to the suction of the pump and an equal quantity of warm brine withdrawn where the coil leaves the tank. Every hour the oil in the tank is turned over by a slow moving agitator. This insures an equal distribution of temperature and precipitated wax.

Chilling is continued until the desired temperature for centrifuging is reached. Chilling by the above method to —10 deg. F. and centrifuging at that temperature will produce a bright stock from most crudes of 15 deg. F. cold test.

Chilling at a slower rate than that given above has shown no advantage in cold test and is more expensive in equipment. More rapid chilling causes an increase in cold test, the increase becoming more rapid as the time of chilling is reduced. A rate greater than 5 deg. F. gives poorer results than chilling more slowly and centrifuging at a higher temperature.

If instead of maintaining a small differential between the brine and oil, slow chilling is accomplished by allowing a small quantity of brine to enter the chilling coil, a portion of the oil is exposed at once to a low temperature, resulting in what we have termed "shock" chilling. As a result the wax is precipitated throughout the oil in a colloidal state, and cannot be separated by gravity or centrifugal force.

It is important, therefore, in order to insure an economical use of refrigeration and an effective use of the centrifuge, first to dissolve the wax completely and then slowly and uniformly chill the mixture to the required temperature for centrifuging. There are three conditions that must be fulfilled in the dilution of the cylinder stock. These are: First, the viscosity must be sufficiently reduced to permit crystal formation rather than colloidal precipitation, and to permit the removal of the wax after it has precipitated. Second, the density of the mixture must be reduced below that of the wax. Third, sufficient volume of liquid must be provided for free suspension of the precipitated wax.

The first two conditions are easily accomplished by using one and one-half volumes of naphtha of about 60 deg. Bé. With some cylinder stock, however, such as those from Wyoming crudes, the wax content is so high that the wax particles begin to crowd each other, joining together before precipitation is complete. Satisfactory separation is then difficult. In some such cases the use of slightly more naphtha than usual is sufficient; in others, better results can be obtained by precipitating half the wax, removing it by centrifuging, and then completing the precipitation by further chilling and recentrifuging.

Colloid Removal and Yield

The presence of asphaltic material and coloring matter in an oil will lower its cold test. A black cylinder stock, which has a cold test of 40 deg. F., after acid treatment and filtration will have a cold test of 85 deg. F. These same substances interfere with the precipitation of the wax in the production of bright stock. If a black cylinder stock be put through the dewaxing process, its cold test may be reduced to 10 deg. F., but on treating to a light color, it will rise to 35 deg. F. It is common practice, therefore, in order to carry on the dewaxing most effectively, to refine the cylinder stock to the required color before dewaxing.

With the cold-settling process, it was common to secure a yield of only 70 per cent of bright stock with a cold test of 50 deg. F. The centrifugal separation of the precipitated wax gives a yield of 85 per cent of 15 deg. F. cold test bright stock, because of the greater freedom of wax from oil.

Extensive investigations have been carried out to determine the possibility of using the centrifugal process for the general removal of wax from all lubricating stocks. The results have shown that the process is readily applicable to any stocks containing the wax in an amorphous form, but that additional considerations are involved in the removal of wholly crystalline wax. It has been found especially applicable to what we have designated as "long residuum"—that is, a steam-refined still residue, similar to cylinder stock but amounting to about 30 per cent of the crude (all of its lubricant) instead of 15 per cent.

The long residuum is treated, as is cylinder stock, for wax removal. A yield of 84 per cent of dewaxed oil and 16 per cent of wax is obtained. The finally dewaxed oil contains all of the lubricating content of the crude, without any having been broken down by a cracking distillation as is necessary when neutrals are dewaxed by pressing. The dewaxed residuum may then be split up by distillation into neutrals and bright stock. It is possible by this method of refining to obtain 10 per cent of 200 sec. viscosity neutrals and 15 per cent of bright stock from a Pennsylvania crude, when formerly not over 5 per cent of 200 sec. viscosity neutral was obtained. The cold test of the neutral will be below 25 deg. F. and that of the bright stock below 15 deg. F.

New Light on
Chamber Sulphuric Acid

Translation of a Notable Paper Entitled "Researches on the Formation of Sulphuric Acid by the Chamber Process"

By E. Briner and M. Rossignol
Laboratory of Technical and Theoretical Chemistry, Geneva, Switzerland

Translated by F. C. Zeisberg

IT IS well known that numerous researches have been undertaken on a study of the mechanism of the formation of sulphuric acid by the chamber process. In spite of the results obtained and the very real progress made in the industry, however, there still remain, in the knowledge of this mechanism, a large number of obscure points.

Recently this problem has been studied in the laboratory of technical and theoretical chemistry of the University of Geneva, by the aid of the modern gas technique in use in these laboratories. Several series of researches, carried out under the direction of the late Prof. Ph. A. Guye and one of us, have been aimed at a study of the formation of sulphuric acid in its initial phase. (See in particular Max Forrer, Thesis, Geneva, 1923; E. Bitterli, Thesis, Geneva, 1922.)

In the present work, by modifying somewhat the apparatus and the operating methods, we have studied this reaction not only in its primary phase but in its entirety; the results thus obtained may consequently present a more or less direct technical interest.

In the progressive march of the formation of sulphuric acid in the chambers, the only data, however but little complete, known up to the present are those, become classic, made by Lunge and Naef in their beautiful experiments in the factories of Uetikon in 1884. (See Lunge, Handbuch der Schwefelsäurefabrikation, Braunschweig 1916, p. 963.) From these it may be seen in particular that nearly 75 per cent of the SO_2 is already transformed into H_2SO_4 when the gas mixture reaches the second half of the first chamber, which testifies to the speed of the reaction at the start.

The data of Lunge and his collaborators are particularly useful in the industry because obtained on the plant itself; but because of this very fact they correspond only to very definite and limited conditions —namely, to a procedure which does not vary too much from normal. But if one wishes to proceed with the systematic study which a problem of this scope merits, it is necessary to operate with widely varying conditions, which is impossible in the factory, but realizable in the laboratory provided suitable apparatus can be conceived. We have accomplished this end, thanks to the equipment and operating methods used by us. These methods were inspired largely by those employed and perfected by our predecessors, and most particularly by the improvements made by M. Bitterli.

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The principle of the method of operation was to circulate the gaseous constituents, SO_2, $NO_2(N_2O_4)$, H_2O, O_2 and N_2, regularly and in proportions and amounts perfectly determined and measured, through the set-up forming the reaction chambers. (For the experimental realization of these conditions we would refer to the above-mentioned researches, as well as to the thesis of M. Rossignol, Geneva, 1922.) It is in this set-up that our apparatus differs particularly from those employed in the preceding researches: the reaction chamber being composed not of a single but of seven adjacent elements, as shown in the accompanying Fig. 1.

The gases are separately led in through the tubes *a*, *b*, *c*, and the three spirals *S* are provided in order that the gases may come to the temperature of the thermostat before being mixed with one another. They then mix in *m* and pass successively through the seven vessels consisting of tubes lying side by side and terminating below the capillaries, which in turn connect with calibrated tubes used to measure and remove the acid formed in each chamber.

It was thus possible to determine the amount of liquid formed in each chamber after a greater and greater and exactly determined time of contact, since this was a function of the yield and capacity of each

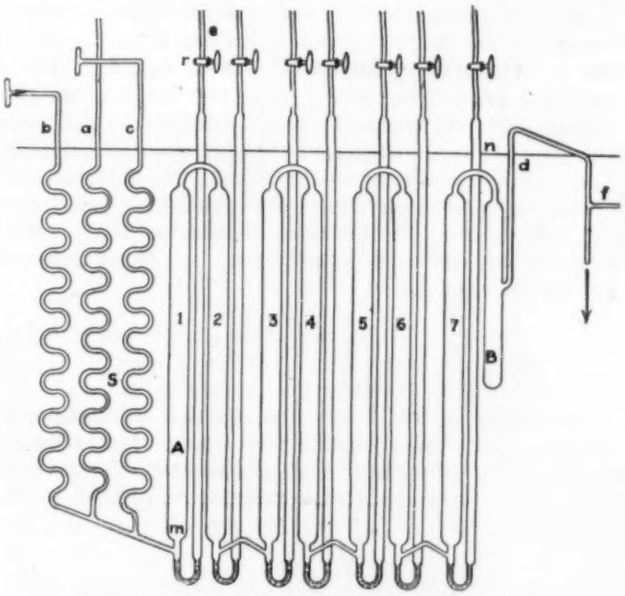


FIG. 1—APPARATUS SHOWING THE 7 REACTION CHAMBERS

TABLE I

Run No.	Liters Gas Per Hour	Composition of Gas Mixture, Vol. Per Cent SO_2	NO_2	H_2O	O_2	N_2	Concentration Factor
11	34.76	3.66	1.08	12.45	6.71	76.10	1.0
12	33.05	4.96	1.64	18.86	10.22	64.32	1.5
13	33.82	6.36	2.34	25.25	13.87	52.12	2.0
14	33.88	8.27	2.82	33.38	17.14	38.49	2.5
15	35.02	9.77	3.34	39.72	20.64	26.53	3.0

TABLE II

Run No.	Theoretical Yield of H_2SO_4 at Exit From Chamber 1	1–2	1–3	1–4	1–5	1–6	1–7	Concentration Factor
11	1.81	3.62	5.18	6.75	8.05	9.45	10.34	1.0
12	4.72	10.57	15.54	19.02	22.82	26.07	29.32	1.5
13	7.25	17.06	25.40	31.08	34.80	39.23	43.36	2.0
14	13.37	28.92	45.71	55.89	64.71	73.37	76.12	2.5
15	19.08	40.24	66.20	80.45	85.14	86.18	87.27	3.0

chamber. The analysis of the liquid formed then gave directly the amount of SO_2 transformed into sulphuric acid; we shall designate this proportion the "yield" of the operation.

Among the numerous results obtained in the course of our experiments (a detailed description of which will be found in the thesis of M. Rossignol), we wish to call attention in this paper to those which appear to us most interesting—viz., those relative to the influence, on the yield, of the gross concentration (or of the pressure) of the reacting gases, and more especially of the concentration of the nitrous gases.

Effect of the Gross Concentration

Using nitrogen as a diluent, we varied the gross concentration of the reacting constituents of the system in the ratio 1 to 3. Tables I and II contain the numerical data of these experiments, the results being shown graphically in Fig. 2. These experiments were all carried out at a temperature of 85 deg. C. (185 deg. F.)

As may be seen, the speed of formation of sulphuric acid is greatly increased by increase of concentration. The relative concentrations are designated in the table under the heading "Concentration Factor."

It is also noticeable that curve 15 bends sharply after the fourth chamber. Its form is hence similar to that representing the data of Lunge & Naef. This same form, moreover, is found in all our curves corresponding to concentrations giving almost complete reaction; it is hence a characteristic of this phenomenon.

At first glance the different curves corresponding to concentration factors increasing from 1 to 1.5, 2, 2.5 and 3, appear to be unrelated, one to another. But if parallels are drawn to the reaction duration axis, it becomes evident that the times corresponding to equal amounts of SO_2 transformed (yields) are approximately inversely proportional to the square of the intial concentration. In other words the times t_1, t_2, read from the intersections of the same parallel with the curves representing the concentrations c_1, c_2, satisfy approximately the equation:

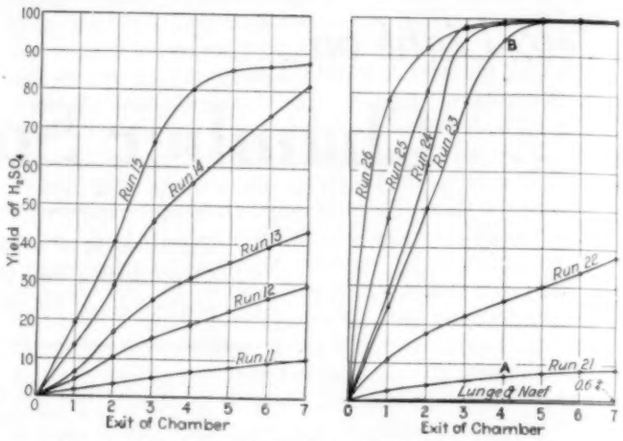
$$\frac{t}{t_1} = \left(\frac{C_2}{C_1}\right)^2$$

if t_1 and c_1^2 are constant.

According to this result the reaction belongs to the third order, since, according to the method proposed by Ostwald (Lehrbuch der allgemeiner Chemie, vol. 3, p. 236) the order n of a reaction is defined by the equation:

$$\frac{t_1}{t_2} = \left(\frac{C_2}{C_1}\right)^{N-1}$$

Instead of varying the gross concentration by dilu-



FIGS. 2 AND 3—ACID YIELDS CORRESPONDING TO TABULATED DATA

tion the pressure may be changed, which leads to the same result, because these two factors are proportional to each other. The series of experiments which we made at 0.5 atmosphere and at 1 atmosphere led us to the same conclusion. (There is in existence already the experience of Pozzi Escott on the influence of pressure, told in several sentences in *Chimie et Industrie*, 1920, vol. 4, p. 645. According to this, and in agreement with our results, the proportion of sulphuric acid formed is almost quadrupled when the pressure of the gas admitted to the chambers is doubled.)

It is thus possible to say that the formation of sulphuric acid in the chambers occurs according to a process of the third order, in which, as a consequence, three molecules simultaneously participate. This is an indication of the theoretical order, which may be useful in establishing the exact mechanism of the formation of sulphuric acid in the chamber process.

Effect of the Concentration of the Nitrous Gas

The concentration of the nitrous gas is of particular importance, because these oxides function as oxygen carriers and it is they, after all, which render the reaction technically utilizable. (It should be recalled, and this has been established by industry and confirmed by the preceding researches, that for water as well as sulphur dioxide there exist optimum concentrations above and below which the yield and production of sulphuric acid diminish.)

Tables III and IV give the numerical data of our experiments, the results also being shown in Fig. 3.

Inspection of the table and the graph reveals the enormous influence exercised by the concentration of

TABLE III

Run No.	Reaction Temp., Deg. C.	Liters Gas Per Hour	Composition of Gas Mixture, Vol. Per Cent SO_2	NO_2	H_2O	O_2	N_2
21	85.0	17.5	8.32	0.5	47.41	16.75	27.02
22	85.0	17.33	8.28	1.23	47.23	16.68	26.58
23	85.0	17.5	8.15	2.46	46.43	16.44	26.52
24	85.5	18.27	8.06	3.69	45.84	16.23	*26.18
25	86.5	16.92	8.01	4.27	45.56	16.12	†26.04
26	86.0	17.44	7.94	4.92	45.03	15.99	26.12

* Total flow a little too great.
† Total flow a little low.

TABLE IV.

Run No.	Theoretical Yield of H_2SO_4 at Exit From Chamber 1	1–2	1–3	1–4	1–5	1–6	1–7
21	2.69	4.27	5.69	6.72	7.76	8.29	8.80
22	10.99	17.74	22.35	26.27	29.87	33.77	37.58
23	23.84	49.85	77.44	94.42	99.16	99.63	99.70
24	27.96	60.82	94.12	99.16	99.60	99.82	99.88
25	48.70	80.90	97.90	98.97	99.38	99.57	99.78
26	78.38	91.74	97.43	98.37	99.02	99.34	99.63

the NO_2. Indeed, curve 1 is an adaptation to our scale of the curve drawn by Lunge and Naef and representing the normal course of the reaction in the industry. As for curve 21, this was obtained by us with a gaseous concentration in general stronger, used in this series of experiments, but in which the NO_2:SO_2 ratio was sensibly the same as in the industrial experiments of Lunge and Naef.

If curves 21 and 23, for example, are compared at points *A* and *B*, corresponding to the exit from our fourth chamber, it will be seen that the sole fact of utilizing NO_2 content of 2.48 per cent instead of 0.5 per cent causes the proportion of SO_2 transformed to rise from 6.72 per cent to 94.42 per cent.

These results lead to a consideration of what happens in the industrial process. The idea of forcing the content of nitrous gas is not new and many specialists put it into practice during the late war; the production of the chambers was increased precisely by augmenting the concentration of nitrous gas in them, but in very narrow limits as compared with those used in our experiments, for the classical industrial apparatus of the chambers is not able to withstand these high NO_2 concentrations used by us.

With the increases in NO_2 concentration realized in the industry, it was thus possible with intensive operation to achieve a production of 6 to 7 kg. of sulphuric acid per day per cubic meter of chamber space, when with normal operation an average of 3 kg. was produced, these figures corresponding to about 6 hours' time in the chambers for the gas.

Striking Effect of Increasing NO_2

In order to compare these data with those obtained in our experiments, let us consider the amounts of sulphuric acid formed in the seven chambers of our apparatus. Their total volume being about 182 c.c. with a gas rate of 17.5 liters per hour, the gases remained in the apparatus 41 seconds. A very simple calculation made, for example, on experiments 21 and 23 leads to the following results:

	Test 21	Test 23
NO_2 content (NO_2 : SO_2 ratio the same as in industry)	0.5 per cent	2.46 per cent
Daily production H_2SO_4 per cu.m. chamber space (66 deg. H_2SO_4)	2.44 kg.	30.44 kg.

It is evident from this comparison that the sole increase in the NO_2 concentration, in the proportion of about 1:5, caused an increase in the production of sulphuric acid per cubic meter of chamber space in the proportion of 1:12.5. These results emphasize, in contrast with industrial conditions, the intensive progress of the reaction which would be realized with much higher NO_2 concentrations.

It should be remarked that in our experiments the boundary surfaces, relatively much more extended than in the lead chambers, and the gross concentration, higher than that in the industry, added their effect to that resulting from the increase in the NO_2 content. (The accelerating action of these surfaces has been especially emphasized by the experiments of Lunge and Naef.) It is the action of all these factors that enabled us to obtain velocities of reaction very much higher than those obtained in the industry (compare curve 1 with curves 23-26).

As an accompaniment of this very strong acceleration, we have noted, as might have been expected, losses of nitrogen oxides much higher than in industry. Moreover, with intensive operation, the much more rapid attack of the materials of construction must be remembered.

However, these several results show that the manufacture of sulphuric acid by the chamber process may undergo possible improvements in the sense of a great increase in the speed of formation of sulphuric acid, if it is operated under pressures above atmospheric or if the concentration of the reacting constituents is raised, or especially if the concentration of the nitrous gas is raised. But the principal advantage of such an acceleration resides in the reduction, realizable in a considerable measure, of the dimensions of the installation.

It is thus only necessary to know, and on this point the manufacturers are in a better position to judge than we, if this advantage compensates for and to what extent, the unfavorable factors, which are, among others: a higher niter rate, the additional expense of an installation capable of supporting the higher pressure (if the process is carried out above 1 atm.), the replacement of lead by a material (silicon-iron or the like) better resisting the corrosive action of the acids.

These are the new operating balances to establish, for which laboratory studies, of the nature of those presented in the foregoing, may perhaps be of service.

How Aluminum Paint Is Made

"Aluminum powder for paint is made by stamping sheet aluminum into very thin and small flakes. These are carefully sized by a series of sieves to give a uniform product. For some purposes it is desirable that the powder have a high luster, and a special polishing process is then employed to finish this grade of powder. Polished powder is always used where a brilliant and highly reflecting surface is desired.

"The shape of the particles of aluminum powder is of particular interest. The ordinary pigment materials like zinc oxide, red lead, white lead, etc., are composed of particles distinctly granular in form, even though they be exceedingly small. Aluminum powder is, however, essentially flake-like in character because of the stamping process used in its manufacture. When polished aluminum powder is suspended in a vehicle like varnish, a curious phenomenon can be observed. The little particles of aluminum swirl about in the liquid and many of them come to the surface of the liquid, where they remain. Very quickly an almost continuous film of metallic aluminum is formed at the surface of the varnish by the little flakes of aluminum, which arrange themselves, in layer upon layer, much like fish scales. The aluminum particles appear to float upon the liquid, but it is really a surface tension effect which holds them there; the phenomenon is descriptively called 'leafing.' This unusual distribution of the pigment in the vehicle confers unusual properties upon the paint. From the standpoint of appearance, the metallic film, almost as highly reflecting as a sheet of polished aluminum, is very attractive. It is also very useful."

This and other interesting information regarding properties, costs and uses of aluminum paint in structural and chemical plant work are given by a pamphlet "Aluminum Paint," written by Junius D. Edwards, assistant director of research of the Aluminum Company of America. Copies of the pamphlet are obtainable from the Pittsburgh offices of the company.

Combustion

The Articles Published Herewith Have Significant Bearing on the Technology of This Unit Process and as Such Are of Interest to Production Men in the Chemical Engineering Industries

How to Select and Use Gaseous Fuels

Notes on Some of the Factors That Govern the Efficient Utilization of the Various Gases Most Often Employed as Industrial Fuels

BY CARL J. WRIGHT
Chief Technologist Combustion Utilities Corporation

IN CONSIDERING the application of gaseous fuels to industrial heating, it is necessary to strike a balance between the economical generation of the gaseous fuel and its efficient utilization. The goal is a gaseous fuel which not only has a high efficiency of utilization but also can be manufactured very cheaply. This involves a thorough knowledge of all the factors that affect the efficiency of utilization of gaseous fuels. It involves knowing the reasons why one gaseous fuel can be utilized with a greater efficiency than another. And an understanding of these matters involves both an analysis of the essential characteristics of combustion of different fuels and the practical consideration of the application of these data in the utilization of these fuels.

It is generally acknowledged that gaseous fuel is the most efficient of our present-day commercial fuels, but it is only in recent years that engineers have realized that one gaseous fuel may be more efficient than another; that the B.t.u. of one gas can do more work than the B.t.u. of another. Heat, like many other commodities, has two criteria of value: quantity and quality. The value of a fuel is not only a function of the quantity of heat contained in unit weight or volume but also of the quality or effectiveness of utilization of the heat. Gaseous fuel is generally purchased today on a basis which largely disregards quality and only partly considers quantity of heat. In most cases, gas is sold at a price per thousand cubic feet, the gas being of a certain heating value which is controlled by some regulatory body. From a common-sense standpoint, it would seem that gaseous fuels, or any other fuels, should be purchased on a heat quantity basis, which also provides for certain standards and specifications which assure the desired quality of heat.

TABLE I—COMBUSTION DATA OF INDUSTRIAL GASES

Kind of Gas	B.t.u. Per Cu.Ft. of Gas (Gross)	B.t.u. Per Cu.Ft. of Gas (Net)	Net B.t.u. Per Cu. Ft. of Air-Gas Mixture	Net B.t.u. Per Cu. Ft. of Products of Combustion	Theoretical Flame Temperature, Deg. F.
Natural gas	1,131	1,025	87.7	86.6	3,325
Coal gas	636	570	86.0	89.5	3,410
Blue water gas	310	285	97.0	102.0	3,565
Producer gas	157	148	66.8	73.0	2,860

The quality of a fuel can be determined with considerable exactness by a study of the more essential characteristics of the combustion of the different fuels. The most important of these are:

1. B.t.u. per cubic foot of the products of combustion.
2. Theoretical flame temperature.
3. Rate of flame propagation.

B.t.u. per Cubic Foot of the Products of Combustion—By the first essential characteristic, calorific value per cubic foot of the products of combustion, is meant the number of heat units that are contained in a cubic foot of gas immediately after combustion and before any heat has been dissipated. Many persons think that the heat value per cubic foot of the fuel is an indication of the relative quality of that fuel. The impression seems to prevail that a natural gas of 1,000 B.t.u. per cubic foot is a better quality fuel than a city gas of 600 B.t.u., which in turn is a better quality fuel than a blue water gas of 300 B.t.u. This is not correct. The heat value per cubic foot of fuel gas is merely a quantity term and has no bearing on quality.

This point is illustrated in Table I. Note that blue water gas contains the greatest number of heat units per cubic foot of the products of combustion and, therefore, should be the most efficient gas, while producer gas has the least number and would, as a consequence, show the lowest efficiency.

Many engineers advocate using the B.t.u. per cubic foot of the air-gas mixture as an indication of the quality of the fuel. This is much better than using the B.t.u. value per cubic foot of fuel gas, but is not the correct value to use. An analysis of the figures will show that there is no relationship between the B.t.u. per cubic foot of the air-gas mixture and the final B.t.u. in the products of combustion which contain the heat in the form in which it is utilized. This is due to the fact that in some cases the volume of the products of combustion is equal to the volume of the air-gas mixture, while in other cases there is considerable contraction in the products. The best indication of the relative quality of fuels is given by the value of the B.t.u. per cubic foot of the products of combustion.

During combustion, the chemical energy in the fuel gas is transformed into heat energy. This heat energy is embodied in the products of combustion and raises them to a very high temperature, called the temperature of combustion. The more heat units developed in a cubic foot of products of combustion the higher the temperature of the flame and the more heat available to perform useful work. Thus, if 1 cu.ft. of the products of combustion of a natural gas contains 86.6 B.t.u., while a blue water gas has 102 B.t.u., it is evident that the blue water gas will have a higher flame temperature and will, therefore, be the more effi-

This article represents the viewpoint of the entire organization of the Combustion Utilities Corporation, gained by years of experience in combustion engineering work. In preparing and editing such manuscripts, the author functions in his capacity as chairman of the technical service staff.

TABLE II.

Kind of Gas	B.t.u. Per Cu.Ft. of Products of Combustion (Total)	B.t.u. at 2,000 Deg. F. Per Cu.Ft. Products of Combustion	B.t.u. Available for Useful Work Per Cu.Ft. of Products of Combustion	Percentage of Heat Available for Useful Work
Blue water gas	102	47	55	54
Producer gas...	73	47	26	35.6

cient fuel. This point can best be illustrated by several examples.

Table II compares blue water gas and producer gas in a heating operation in which the products of combustion leave the furnace at 2,000 deg. F.

In this example the blue water gas is about one and one-half times as efficient as producer gas.

The temperature of the flue gases leaving the furnace is an important factor in determining to what extent the heat in the products of combustion enters into the relative efficiency of fuels. Generally speaking, the lower the temperature at which the flue gases leave the furnace the less important the relative heating units in the products of combustion; the higher the temperature of the flue gases the greater the importance of considering the B.t.u. per cubic foot of the products of combustion.

Assuming that the fuels shown in the above example are used in a heating operation where the flue gases are cooled to 60 deg. F.; then all the heat in each fuel would be available for useful work. Hence the possible efficiency for each fuel would be 100 per cent. But in a boiler operation when the flue gases leave at 500 deg. F., the conditions shown in Table III prevail.

On the basis of the above considerations, the accompanying chart has been prepared to show the replacement values of the various fuels as compared with natural gas. At 60 deg. F. the replacement value is inversely proportional to the calorific value of the fuels, but at higher temperatures it takes less blue water gas and more producer gas to displace a given amount of natural gas.

In cases where the flue gases leave the furnace at 60 deg. F., the heat units of one fuel are equivalent to the heat units of any other. Thus, to displace a million B.t.u. of natural gas, a million B.t.u. of producer gas, coal gas or blue water gas will be required; to displace 100 cu.ft. of 1,131 B.t.u. natural gas, it is necessary to supply as many cubic feet of another fuel as the number of B.t.u. of this fuel is contained in the B.t.u. in 1 cu.ft. of natural gas.

Among the various types of commercial fuel gases, the industrial user is more than likely to be at a loss when trying to determine which will best suit his purposes. There are two main criteria by which the fuel gases may be judged: quantity of heat and quality of heat. Just what relation these two factors should bear to each other in any choice is the user's problem. In the accompanying paper, Carl J. Wright clearly points out the weight which each of these factors should bear in the choice of a fuel gas and does this in such a way as to be of great help to all gas users.

Thus, to displace natural gas in this particular example with blue water gas of a B.t.u. value of 310, we shall have to supply

$$\frac{1131 \times 100}{310} = 356 \text{ cu.ft. blue water gas.}$$

However, if the flue gases leave at a higher temperature, say 2,500 deg. F., then it is necessary to supply, as shown from the curve, only 292 cu.ft. of blue water gas, or, in terms of B.t.u., we have to supply only 90,520 B.t.u. of blue water gas to do the same amount of work that 113,100 B.t.u. of natural gas will do.

It must be kept in mind that these curves do not consider the other important factors affecting the efficiency of utilization of gaseous fuels, but take into consideration only the factor of the heat quantity per unit of volume of the products of combustion, in conjunction with the volume, specific heat and thermal capacities of the flue gases when leaving the furnace at different temperatures.

TABLE III.

Kind of Gas	B.t.u. Per Cu.Ft. of Products of Combustion (Total)	B.t.u. at 500 Deg. F. Per Cu.Ft. of Products of Combustion	B.t.u. Available for Useful Work Per Cu.Ft. of Products of Combustion	Percentage of Heat Available for Useful Work
Blue water gas.	102	9	93	91
Producer gas...	73	9	64	88

Theoretical Flame Temperatures—The theoretical flame temperature of a gas is the maximum temperature that would be obtained with that fuel if no heat losses occurred. In practice, this temperature is never realized, due to retarded combustion, incomplete combustion, decomposition of products of combustion, radiation from the flame, or the use of excess air. It plays a very important part in the efficiency of utilization and is very closely related to the factor discussed previously—that is, the B.t.u. value per cu.ft. of products of combustion.

As shown above, the theoretical flame temperature is proportional to the net B.t.u. per cu.ft. of the products of combustion. This is true because, generally speaking, the thermal capacities per unit of flue gas of our various commercial gases are approximately the same. Since the theoretical flame temperature of fuel is obtained by dividing the heat content of a unit volume of flue gases by their thermal capacities or specific heats, the theoretical flame temperature of a fuel is, for all practical purposes, proportional to the heat content of 1 cu.ft. of the products of combustion of various commercial fuels.

In any heating operation heat in the products of combustion is given up to the material to be heated as long as the products of combustion are at a higher temperature than the material. The quantity of heat transferred by conduction and convection is in direct ratio to the difference in temperature between the products of combustion and the material being heated, while the heat transmitted by radiation varies as the difference of the fourth powers of the absolute temperatures. The main point to be considered is, therefore, the difference in temperatures. On similar work the end temperature, or that temperature at which the products of combustion leave the furnace, should be the same, irrespective of the fuel used. Thus, it is evident that the flame temperature plays an important part in the thermal efficiency of a furnace. As an example, there is a heating operation requiring a temperature of 2,700 deg. F. in the material, and either blue water gas with a flame temperature of 3,565 deg. F. or a producer gas with a flame temperature of 2,860 deg. F. may be used. It is evident that the quantity of heat which will be given up to the material is that in the

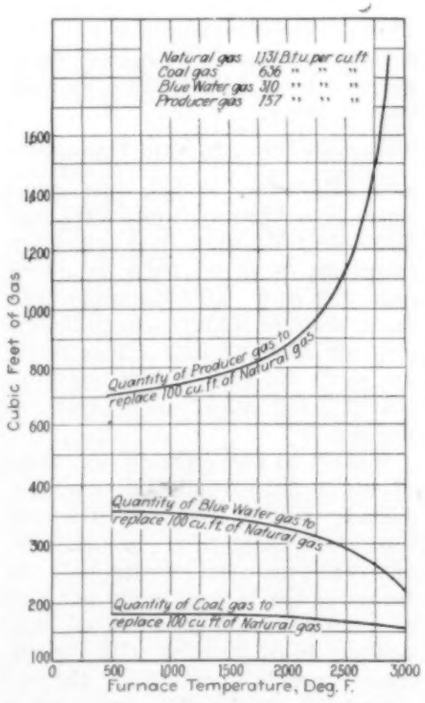
products of combustion in cooling down to 2,700 deg. F. In the case of blue water gas, it is the heat given up when the gases cool from 3,565 deg. F. to 2,700 deg. F., while with producer gas it is the heat given up by the gases in cooling from 2,860 deg. to 2,700 deg. F.

Generally speaking, the higher the flame temperature of a gas the better the efficiency of utilization. This is true because with a greater differential temperature between the flame and the material there is a more rapid transfer of heat. This means increased furnace capacity, decreased labor expense and decreased overhead expense. The foregoing discussion emphasizes the point that one B.t.u. is not necessarily as good as another and that the heat units of a high flame-temperature gas can be more effectively utilized than the heat units of a low flame-temperature gas under similar conditions of application. In other words, the greater the number of B.t.u. contained in a cubic foot of the products of combustion of a gaseous fuel the greater its theoretical flame temperature and, therefore, the greater its efficiency of utilization and the greater the capacity of the furnace in which it is used.

Flame Propagation—The third important characteristic of a fuel is its rate of flame propagation. This property may be defined as the uniform rate at which the flame will travel along a tube or container when filled with a mixture comprising the theoretical air-gas mixture for that fuel. The rate of flame propagation is important from the standpoint of burner design. With a burner which is passing an explosive mixture of gas and air, it is possible to have one of three conditions of burning—namely, the flame may blow away from the tip of the burner; the flame may burn at the tip of the burner, or the flame may travel back into the mixer tube, producing what we term back-fire. Which of these various conditions will prevail is determined by the relation of the rate of flame propagation of the mixture to the rate of supply. In the first case, the velocity of the mixture is greater than the rate of flame propagation and the flame cannot travel back to the burner, but is blown off and extinguished. In the second case, the velocity of the mixture and the rate of flame propagation are equal and we get a "normal flame." In the third case, the velocity of the mixture is less than the rate of flame propagation and the flame travels back into the mixer tube of the burner.

Rate of flame propagation is of greater importance to the combustion engineer than to the burner designer because of the important part it plays as a factor in the efficiency of utilization of a fuel. As was pointed out above, the higher the flame temperature the greater the efficiency. The development of a high flame temperature depends on the speed of combustion, other things being equal, because, if combustion takes place instantaneously, all the heat of combustion is available at once for raising the temperature of the products, and the unburned portion of the air-gas mixture does not absorb heat nor is heat lost by radiation from the flame. Thus one of the very necessary conditions for securing a maximum flame temperature is a high rate of flame propagation.

The rate of flame propagation of a gaseous fuel gives the rate at which the gas burns and therefore gives the rate at which heat units can be liberated in the furnace. It is evident that in a certain size furnace if we use a gaseous fuel which has a rate of flame propagation twice as rapid as another fuel, the first fuel can be made to liberate twice as many heat units per unit of time as the second fuel. This means that having more heat units in the furnace per unit of time, more heating can be done and therefore the furnace has greater capacity and better efficiency.



REPLACEMENT VALUES OF VARIOUS FUELS COMPARED WITH NATIONAL GAS

Hydrogen and carbon monoxide in separate containers of equal cross-sectional area, each intimately mixed with the theoretical amount of air for combustion, when ignited will show that the flame travels much faster with hydrogen than with carbon monoxide. This shows that the rate of flame propagation is dependent on factors other than intimate mixtures. It is evident that a fuel which is high in hydrogen content will have a higher rate of flame propagation than another fuel which has a low hydrogen content.

Generally speaking, the simpler gases, such as hydrogen and carbon monoxide, have higher rates of flame propagation than the complex hydrocarbons, such as methane, ethane, ethylene, etc. These complex gases have low rates of flame propagation, probably due to the fact that they must first be broken up into carbon and hydrogen before they can combine with oxygen. The gases with high hydrocarbon content are generally slow-burning fuels and therefore less efficient than fuels which burn at a faster rate.

The above discussion shows that the efficiency of utilization of a fuel is dependent upon the heat units contained in a cubic foot of the flue gases, the theoretical temperature of combustion, and the rate of flame propagation. Aside from these considerations there are a few other points that should be considered in selecting an industrial fuel. The chemical composition of both the fuel gas and the products of combustion must be such that the working material will not be contaminated. Generally speaking, the presence of sulphur compounds in a fuel is very undesirable and produces harmful effects upon the material in the furnace. In many cases the presence of excess air is chemically undesirable (it is always undesirable from an efficiency standpoint), because it provides free oxygen, which is active at high temperatures and causes rapid oxidization of the material. There are a few cases where it is important to avoid a deficiency of air because of the harmful effects of carbon monoxide on the refractories of the furnace or on the working material.

Equipment News

From Maker and User

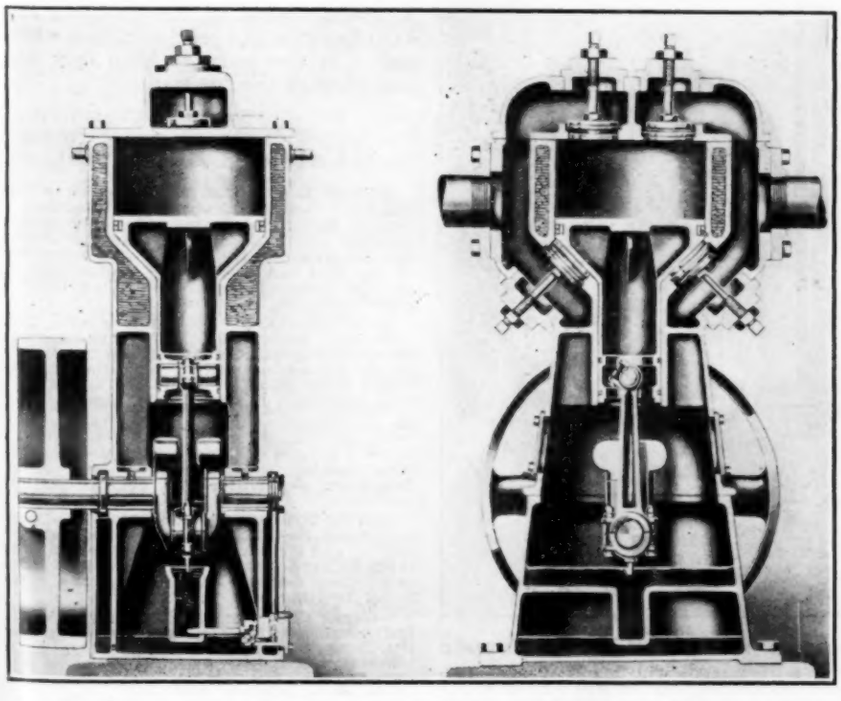
Small Vertical Vacuum Pumps

Those who use small-capacity vacuum pumps will be interested in the new line recently put on the market by the Ingersoll-Rand Co., 11 Broadway, New York. This line consists of small vertical belt-driven vacuum pumps and is called the 'type 15."

These pumps come in six sizes—4x2 in., 5x3 in., 6x4 in. and 8x5 in. single-acting pumps; 10x5 in. and 12x6 in. double-acting pumps. The single-acting pumps are air cooled by means of an annular ring which encircles the cylinder, while the double-acting pumps are cooled by means of circulating water. They produce a vacuum varying from 28.6 in. to 29.25 in., depending on their size. In addition to the standard belt design, each size is built as a self-contained electric motor outfit, using the short belt drive arrangement or driven through pinion and internal gear. The vacuum pump and electric motor of both the short belt and gear driven units are mounted on a metal sub-base, so that they are not dependent on the foundation for correct alignment.

One of the features of the line is the "constant-level" system of lubrication. As the illustration shows, the bottom of the pump base forms an oil reservoir. The amount of oil in this base is determined by high and low level pet cocks. Above the reservoir and directly underneath the connecting rod is a constant-level pan into which the connecting rod dips and distributes the required amount of oil for lubrication.

The constant-level pan is replenished with oil from the supply in the crank case by a valveless oil pump operated by an eccentric on the main shaft. The system is designed so that, as long as the oil is between the level of the two pet cocks, the constant level is kept and the lubrication is thorough.



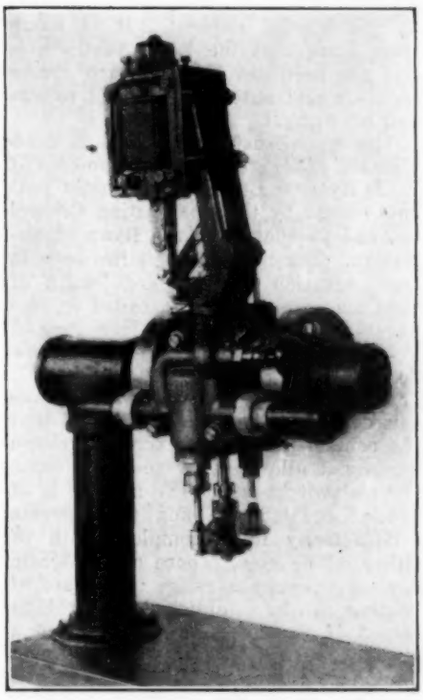
SECTIONS 12x6 "TYPE 15" VACUUM PUMP, SHOWING OILING SYSTEM

Temperature Control for Industrial Heating

Some Notes on the Design and Operation of the Ryan-Austin Temperature Control Device

By J. F. Ryan
F. J. Ryan & Co., Philadelphia, Pa.

Industrial heating as it pertains to the use of oil or gas as a fuel is passing through one of its most critical stages. First, because oil gives indication of ceasing to be available for general industrial purposes within 50 years. Second, because an energetic effort is being made to re-establish the use of gas, especially gas manufactured as a byproduct in coking operations. And third, because of the demands for accurate temperature control made necessary by modern specifications.



THE RYAN-AUSTIN TEMPERATURE CONTROLLING DEVICE

Research work on the part of heat-treating societies and metallurgists has proved that wide changes take place with slight under- or over-heating beyond any particular standard established by the original test. It is because of the knowledge of this fact that the electric furnace has been adopted so widely, notwithstanding its additional cost both upon the initial installation and for fuel charges.

In dealing with heat for the treatment of metallurgical products or, in fact, for any purpose there are two conditions to be recognized. First, the mechanical effect that may take place because of residue resulting from combustion with fuel as against the lack of such residue in the use of electric heat; and second, the temperature control. By the temperature control we mean the keeping within close limits, say 5 deg. F., of the furnace temperatures as gaged by an accurate scale set down on the preliminary or test treatment.

Industry in general is still dependent to a very large degree upon the use of fuel such as coal, oil or gas in its heating operations. While the future will no doubt solve the problem of reduced electric current cost so that there will be a steady increase in the ap-

plication of electric heat for industrial purposes, the problem at present is how to improve the handling of oil and gas as fuels so as to obtain the accurate results and the economical operation that are absolutely necessary. The value of the electric furnace is largely in its automatic control. By automatic control is meant operation according to a program with no manual operation except for setting, and the elimination of the human element. It is along these lines that the Ryan-Austin control has been developed toward giving accurate and automatic control to gas and oil firing.

The Ryan-Austin control is a combination of designs and developments of F. J. Ryan & Co. and the Austin patents owned by the Combustion Control Co. and purchased by the Ryan organization. The complete unit has been in test operation for extended length of time and is now being installed on furnaces for the U. S. Cast Iron Pipe & Foundry Co., National Cast Iron Pipe Co., and on large boilers for the Pusey & Jones Co. The features which make this control unique are in the fact that the control impulse is exerted through a magnet allowing for remote control from a switchboard. The magnet is of special construction and will operate satisfactorily in a complete bath of either oil or gas. There are program devices whereby a range program of heating can be established. By this is meant if it is desired to bring up a product in, say, 4 hours with a 20 deg. rise every 30 minutes from the mean starting point, the program recorder can be set and a repetition of this condition will take place automatically until such a time as the recorder is again set for some other program.

There is also a unique equalizing control by setting, whereby with the turning of one control wheel the setting of the air and oil or gas and oil is established in accurate ratio. This eliminates any difficult settings after the valve has once been established for its operation. An important feature of the valve is that sections can be removed and an increased or a decreased size valve be inserted making the unit adjustable to variable plant operating conditions.

In an operation at the Hess Bright Co. of Philadelphia, where charges have to be inserted and taken out very often, the temperature drop is less than 20 deg. with the opening of the doors and a complete recovery to normal is obtained within 3 minutes. In a recent installation in one of the government departments an experiment was made on the bright annealing of brass tubing. It was found that a perfect annealing could be secured and the bright refinish retained by the accurate temperature control with an entire elimination of scale, indicating that the bright annealing problem is directly related to temperature control. In addition to the claims for the elimination of man-power and the accuracy of temperatures resulting in a more perfect product, it is claimed that because of the fact that the furnace or the heating medium can be kept within a close operating range at all times, a greater percentage of product is produced due to the elimination of stops on account of overheated or underheated conditions.

The control is adjustable for any types of burners using high- or low-pressure air or steam systems on gas or oil. It is also produced in a special design for the control of pressures in boiler firing.

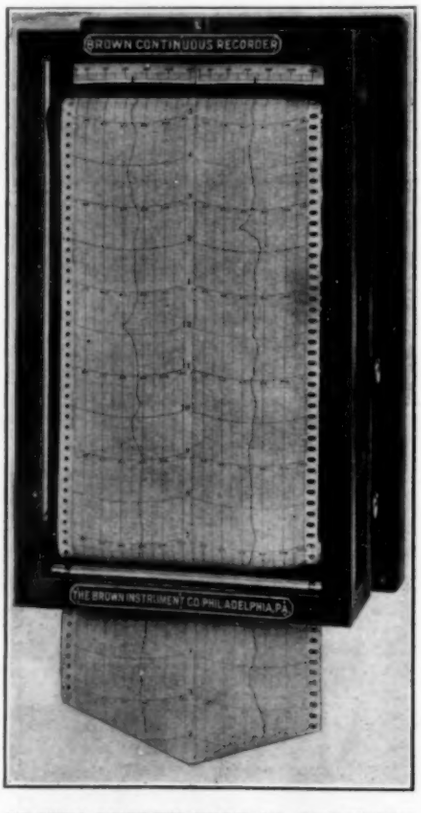
Measuring CO_2 Content

Continued Activity in the Field of Indicating and Recording the CO_2 Percentage of Flue Gases Evidenced by Appearance of New Instruments

The principles of design used in electrical CO_2 meters and flue gas pyrometers are old and well known. It is only recently, however, that these principles have been applied for this purpose. Since that time several of the leading manufacturers have brought out these devices, which are of much interest and worth to those responsible for efficient combustion.

One of the recent examples of such instruments is presented by the indicating and recording electrical CO_2 meters and flue gas pyrometers recently placed on the market by the Brown Instrument Co., of Philadelphia, Pa. These instruments operate on the principle of the difference in thermal conductivity of various gases. A Wheatstone bridge is used in making the comparison, one gas being air and the other flue gas. Two legs of the bridge consist of platinum spirals, one in the air (which is in a sealed chamber) and the other exposed to the flue gas. Hence fluctuations in the flue gas content unbalance the bridge and this effect is used to record or indicate the CO_2 content.

These meters may be located at any desirable distance from the furnaces. Among other advantages claimed, these meters are so constructed that by means of a selective switch, the CO_2 percentage of several boilers may be read on one instrument. On the duplex recorder either the CO_2 percentage of two boilers are recorded on the one chart or the CO_2 percentage is recorded on one side of the chart and the flue gas temperature on the other side of the same chart. By means of this type instrument, using the latter method, the whole story of a boiler is recorded. A special combined thermocouple and sampling tube has been developed which makes it necessary to have only one hole through the flue wall.



BROWN DUPLEX TYPE CO_2 RECORDER

This instrument will record for two furnaces simultaneously or will act as a CO_2 recorder and flue gas pyrometer for a single furnace.

BROWN INDICATING CO_2 METER, WITH ELECTRICAL PANEL ATTACHED

Catalogs Received

WESTINGHOUSE ELECTRIC & MANUFACTURING CO., Stoker Department, Philadelphia, Pa.—A bulletin describing the new model multiple retort underfeed stoker, a stoker that permits positive control of the contour of the fuel bed at all rates of combustion and is designed to minimize loss due to combustible in the refuse.

ESTERLINE-ANGUS CO., Indianapolis, Ind.—Bulletin 1023. A bulletin entitled "Answers to Some Everyday Questions," which shows the use of graphic recording instruments throughout a manufacturing plant.

SUGAR APPARATUS MFG. CO., Philadelphia, Pa.—A pamphlet on the use of the "Lillie" type of evaporator in the United States Navy. Also a folder describing the combined heater, evaporator and feed water flashdown de-aërator for central station service.

LEE B. METTLER CO., Los Angeles, Calif.—Catalog describing various forms of gas and oil and combination burners for various types of furnaces, stack damper indicators and other devices manufactured or marketed by this concern.

DEISTER CONCENTRATOR CO., Fort Wayne, Ind.—Bulletin 10. A bulletin describing the Leahy No-Blind Screen, which is a vibrating screen for materials—wet or dry—from 2-in. opening to minus 80 mesh. It is recommended for coal, coke, clay, sand, gravel, stone, slag and various other minerals.

Review of Recent Patents

Developments in Sulphite and Sulphate Practice in the Pulp Mill

Direct Cooling of SO_2 Gases in Acid Making—Recovery of SO_2 From Blow—Using Sulphur in Sulphate Makeup—Super Bleaching

TO manufacture sulphite pulp at least 200 lb. of sulphur is required per ton of pulp produced. In many mills this amount runs up to 350 lb. per ton. To improve the efficiency of this process George A. Richter and Gordon E. Wightman have recently developed new cooling and waste gas recovery apparatus (U. S. Pats. 1,469,958-9, Oct. 9, 1923) assigned to the Brown Co., Berlin, N. H.

The cooling apparatus departs from usual practice by carrying out the operation by direct instead of indirect contact of the hot SO_2 gases from the burner with cold water. The cooling tower is filled with tile, spiral brick, etc. The spray of water is so regulated that the liquid leaving the bottom of the tower has a temperature of 130 to 190 deg. F. and so when saturated carries from 0.2 to 0.7 per cent sulphur dioxide. To remove this gas as far as possible, about 10 per cent of the tail gas (unabsorbed after passage through the usual lime-filled absorption towers) is run through a recovery tank into which the hot liquor from the cooling tower flows. This tail gas is strengthened in this way up to as high as 8 per cent SO_2 content. Since this is the approximate strength of the gas as it passes from the first absorption tower to the second, it is led back into the system there. The SO_2 content of the tail liquor is reduced by this means to from 0.02 to 0.10 per cent. Several claims of improvement in operation are made, chiefly based on added cooling efficiency. Elimination of sulphur and sulphuric acid, both objectionable, is also pointed out. Greater flexibility of operation without sulphur loss thus results, according to the assertions made.

Recovery of SO_2 in Blow

Attempts have been made in the past to recover the sulphur dioxide in the gases coming from the digester when blown—that is, when the pulp is discharged under pressure. Most of these proposed methods have been found impractical due to the expense and complexity of the equipment required. In the present patent, an arrangement indicated in Fig. 2 is provided.

The gases coming from the blowpit are led into the foot of a wooden condensing tower, which is filled with spiral brick or similar material. Water

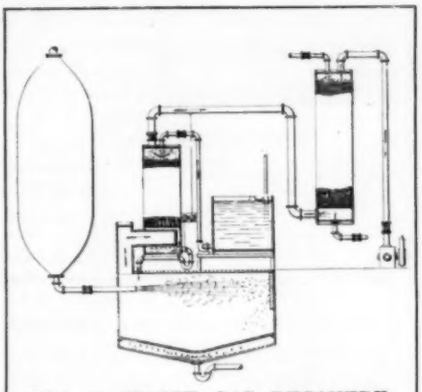


FIG. 2—WASTE GAS RECOVERY

is sprayed under pressure down through this tower. A trapped drain pipe carries this water away. The cooled gases, consisting of N_2, O_2 and SO_2, are conducted from the tower, in which condensible vapors have been removed, to the base of an absorption tower. The SO_2 may be taken out by simple scrubbing with water, by limestone and water or in some other system.

In operation, the blowpit is flushed with steam just previous to the blow to remove O_2 as far as possible. Vacuum is set up in the system by a pump working on the condensing tower and the water sprays in that tower are started. During the countercurrent flow of the water and the gases and vapors, the vapors are condensed by the water. The flow of water through the condenser tower is carefully controlled so that outgoing gas from the tower is maintained preferably below 100 deg. F., and the outgoing water is kept above 180 deg. F., preferably from 190 to 200 deg. F. This stream of water is delivered into contact with the jet of pulp and liquor issuing from the blow and is thoroughly broken up and brought to the boiling point, so that any small amounts of sulphur dioxide gas contained therein are immediately liberated.

The cold water entering the top of the tower effectively condenses all vapors passing upwardly through the tower and cools the remaining gases to a relatively low temperature so that the sulphur dioxide is ready for absorption as calcium bisulphite. As the sulphur dioxide gas from the blow pit comes into contact with the colder water entering the tower, a small amount is absorbed, but as the temperature of the water is gradually increased, more and more of the gas is liberated, until finally, just before the water is raised to the boiling point by its impingement upon the jet of pulp and liquor and all traces of the gas are removed, the water contains about 0.2 to 0.3 per cent sulphur dioxide. The water delivered from the tower, being cooler than the stream of pulp and liquor, not only loses its contained gas but also condenses some of the vapor in the blow pit, thus causing

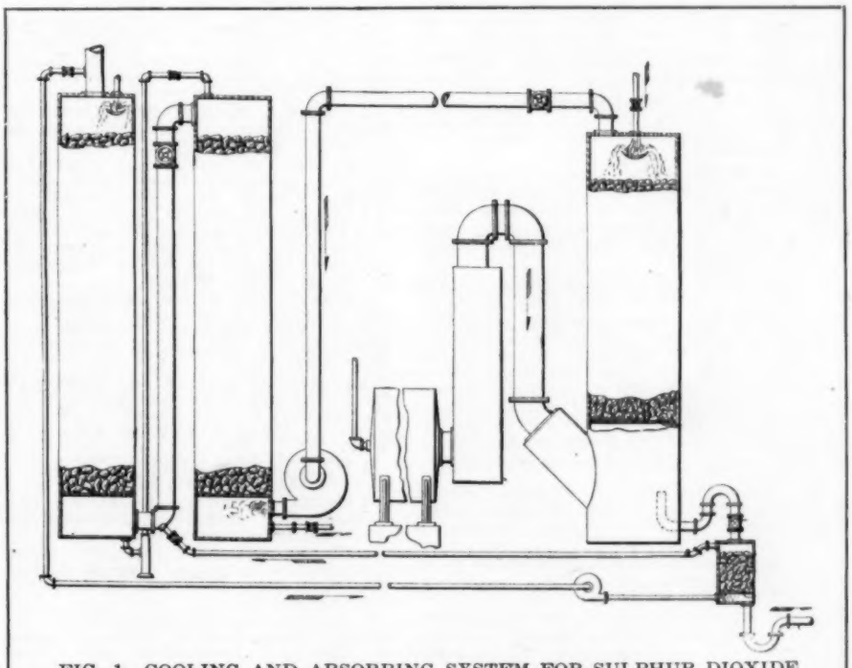


FIG. 1—COOLING AND ABSORBING SYSTEM FOR SULPHUR DIOXIDE

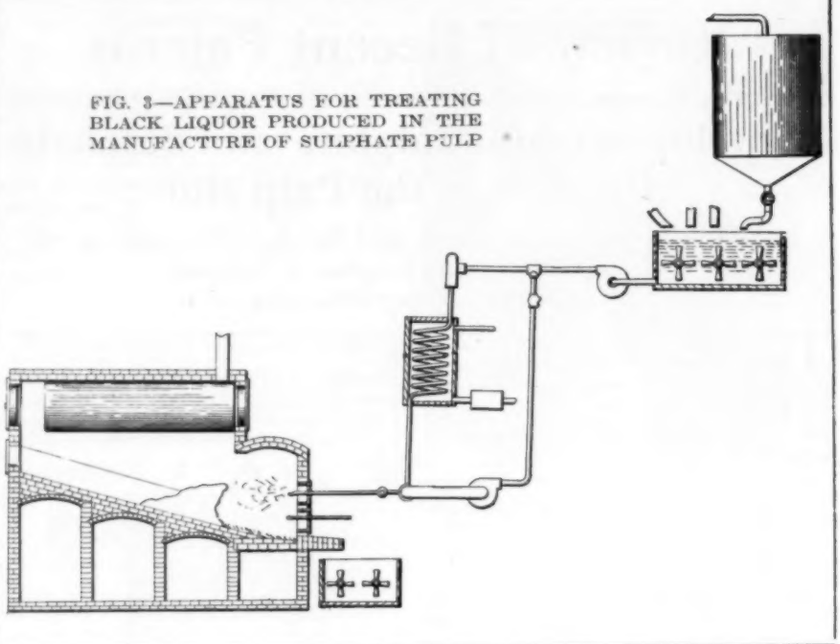
the blow pit to act practically as a part of the condenser system.

Substituting Sulphur for Salt Cake in Sulphate System

In the sulphate process of cooking wood a solution of sodium hydroxide and sodium sulphide is employed. After this cooking solution has reacted with the wood a gummy liquor results called "black liquor." Since the existence of this process on a commercial basis depends upon the recovery of the soda, this black liquor is evaporated and in the usual practice a makeup of sodium sulphate is added. The mixture is then smelted, dissolved in water, any necessary addition of sodium carbonate made, causticized with lime, filtered and then run back into the system.

George Richter and Douglas H. McMurtrie in patent 1,469,960, Oct. 9, 1923, assigned to the Brown Co., Berlin, N. H., point out that instead of maintaining the necessary high sulphide concentration by a salt cake (Na_2SO_4) makeup, sulphur may be used instead. If desired, sulphur and carbonate (Na_2CO_3) may replace Na_2SO_4 altogether. It is claimed that this makes possible a desirable increase of total sulphur to total sodium content of the liquor. Since carbonate may be added either just before smelting or just previous to causticizing, it is possible to control the composition of the resulting liquor very carefully by this method.

FIG. 3—APPARATUS FOR TREATING BLACK LIQUOR PRODUCED IN THE MANUFACTURE OF SULPHATE PULP



Apparatus for carrying out the procedure outlined is shown in Fig. 3. The components S, Na_2SO_4 and Na_2CO_3 are added to the vat in which the concentrated black liquor is run. The mixture is pumped from this tank into a heated coil, where the mixture is "exploded." From this coil the mixture is forced into the upper part of a combustion chamber in which an oxidizing atmosphere is maintained.

American Patents Issued October 30, 1923

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met.* readers. They will be studied later by *Chem. & Met.'s* staff, and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,472,075—Petroleum-Treating Apparatus. Joseph W. Lewis, Philadelphia, Pa., assignor to Atlantic Refining Co., Philadelphia.

1,472,098—Filter. Ernest J. Sweetland, Montclair, N. J., assignor to United Filters Corporation, Salt Lake City, Utah.

1,472,115—Process of Treating Solutions or Metals. Louis F. Clark, Potrerillos, Chile.

1,472,116—Process of Distilling Oil. Henry L. Doherty, New York, N. Y.

1,472,118—Process of Extracting Pine Oil, Turpentine, and Resinous Products From Wood. Taliaferro J. Fairley and Thomas M. Du Bose, Hattiesburg, Miss.; said Du Bose assignor to said Fairley.

1,472,119—Process of Treating Vegetable Matter for the Production or Extraction of Oils, Resinous Substances, Etc. Taliferro J. Fairley, Hattiesburg, Miss.

1,472,137-9—Electric Resistance Furnace. Thomas A. Reid, Pittsburgh, Pa., assignor to Westinghouse Electric & Manufacturing Co.

1,472,166—Acid-Proof Container. Richard T. Griffiths, Akron, Ohio, assignor to Miller Rubber Co., Akron.

1,472,169—Electrolyte for Electrolytic Condensers. Earl J. Haverstick, Oakmont, Pa., assignor to Westinghouse Electric & Manufacturing Co.

1,472,231—Means for Separating Suspended Particles From Gases. Walter A. Schmidt, Los Angeles, Calif., assignor to International Precipitation Co., Los Angeles.

1,472,238—Process of Treating Paper Pulp Stock to Insure Uniform Consistency. George Phelps Berkey, Wisconsin Rapids, Wis.

1,472,239—Coating Composition for Metals and Method of Making Same. William H. Buell, Bronxville, N. Y., assignor, by mesne assignments, to Conversion Products Corporation.

1,472,266-7—Refrigerating Apparatus. Lloyd G. Copeman, Flint, Mich., assignor to Edwin W. Atwood, Flint.

1,472,281—Method of and Apparatus for Hydrogenating Unsaturated Compounds. Carl M. Page, Chicago, Ill.

1,472,294—Process of Purifying Chlorine and Other Corrosive Gases. George O. Curme, Jr., and Harold E. Thompson, Clendenin, W. Va., assignors to Carbide & Carbon Chemicals Corp.

1,472,298—Derivatives of Suprarenin and Process of Preparing the Same. Casimir Funk and Louis Freedman, New York, N. Y., assignors to Herman A. Metz, New York.

1,472,314—Process of and Apparatus for Drying and Treating Materials. Paul W. Webster, Pelham Manor, N. Y., assignor to Perry & Webster, Inc., New York.

1,472,317 — Slime - Pulp Thickener. Charles Allen, El Paso, Tex.

1,472,318 — Corncob Cellulose and Method of Preparation. Frederick C. Atkinson, Indianapolis, Ind.

1,472,324—Process for Making Ester Condensation Products. Ray M. Carter, Baltimore, Md., assignor to U. S. Industrial Alcohol Co.

1,472,333—Disazo Coloring Matter. A. Willard Joyce, Newark, N. J., assignor to Chemical Foundation, Inc., New York, N. Y.

1,472,334—Disazo Dyes. Asa Willard Joyce, Newark, N. J., assignor to Chemical Foundation, Inc., New York.

1,472,343—Process for Obtaining Pure Nitric Acid From Nitrous Gases. Werner Siebert, Laufenburg, Aargau, Switzerland, assignor to Nitrum Aktiengesellschaft, Zurich, Switzerland.

1,472,353—Manufacture of Formaldehyde Condensation Products or Phenols. James Gibbon Byrom, Heaton Chapel, England, assignor to Richard Attwater, Lancaster, England.

1,472,384-5—Process of Separating Hydrocarbons From Water. Walter Arthur Brown, Los Angeles, Calif.

1,472,403—Process for the Synthetic Production of Alkali-Metal Cyanides. Foord Von Bichowsky, Glendale, Calif.

1,472,445 — Conveying Apparatus. Floyd C. Van Eseltine, Eastwood, N. Y.

1,472,472-3—Process of Making Soap Powder. John Charavelle Ingram, Chicago, Ill., assignor to American Cotton Oil Co., New York.

1,472,574—Filtration. Arthur Wright, Upper Montclair, and Frank W. Young, Verona, N. J.

1,472,691—Nitrostarch Explosive. Walter O. Snelling, Allentown, Pa., assignor to Trojan Powder Co., New York, N. Y.

1,472,716—Process of Making Emulsions. Wheeler P. Davey, Schenectady, N. Y., assignor to General Electric Co.

1,472,738-40 — Aluminum-Base Alloy and Method of Treating It. Robert S. Archer and Zay Jeffries, Cleveland, Ohio, assignors to Aluminum Company of America, Pittsburgh, Pa.

1,472,741—Drier. Elwood B. Ayres, Philadelphia, Pa., assignor to Proctor & Schwartz, Inc., Philadelphia, Pa.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Here S burns to SO_2, which combines with carbonate to form Na_2SO_3. A reducing atmosphere of carbon monoxide is created in the lower portion of this combustion chamber. The molten soda flows downward on the sloping floor and so into the vats where it is dissolved. The causticizing and filtering are carried out as usual.

Increasing Whiteness of Bleached Stock

The problem of obtaining very white pulp is involved, in that the elimination of the last of the yellow color usually involves an undesirable change in the composition of the cellulose. To obviate this change but at the same time to obtain an increased degree of "whiteness" George Richter and Elwood Ebie in patent 1,470,556, Oct. 9, 1923, assigned to the Brown Co., Berlin, N. H., have outlined a method of "super" bleaching, to be applied particularly to previously bleached sulphite stock.

A stock, bleached to a point where it shows a color number of 95 to 99, tests high in strength, has a relatively low coefficient of shrinkage in drying, a high percentage of alpha cellulose and relatively low percentages of beta and gamma cellulose, assuming, of course, that the stock has not been injured in the initial liberation of the fiber by the process of digestion. By treating such a stock with a small quantity of chlorine under proper temperature conditions and for a limited period of time, the stock may be super-bleached and whitened to a point where it shows practically no traces of color with practically no diminution in strength and with but slight variations in the relative proportions of the alpha, beta and gamma cellulose.

The pulp is first bleached in the usual manner with calcium hypochlorite solution carrying around 32 grams available Cl_2 per liter. After the action is complete and the pulp has been washed anti-chlor is added, when necessary, to remove the last traces of the chlorine. The second stage or super-bleaching is usually carried out by a solution of Cl_2 in water, an amount equivalent to from 0.2 to 0.5 per cent of the air dried stock being used. Bisulphite solution is then added to the pulp in sufficient quantities to neutralize any resulting hydrochloric acid and to combine with any remaining traces of chlorine. The bisulphite may be added either in the form of sodium or calcium and usually contains an excess of free sulphurous acid. The stock, of course, is agitated, and, after the addition of the bisulphite, sufficient time is allowed to elapse for effecting a complete mixture, and the stock is then thoroughly washed with clean water and is ready for screening, riffling and other subsequent operations. A result much superior to that obtained by direct bleaching with chlorine is claimed.

Books Received

Magnesium

MAGNESIUM. A handbook issued by American Magnesium Corporation, Niagara Falls, N. Y. 177 pages, illustrated.

The American Magnesium Corporation has prepared this handbook of information and data relating to the use of magnesium and magnesium alloys for the service of users and prospective users of these metals. Instead of typical trade literature, conspicuous for its advertising characteristics and of limited technical value, the corporation offers this convenient volume, which is worthy of a place in any metallurgist's library.

The subject matter of the book includes a very brief discussion of occurrence and history of the element, a careful presentation of the chemical and physical properties of magnesium and its alloys, a very complete résumé of the properties and nature of magnesium alloys illustrated by equilibrium diagrams, a splendid summary of the mechanical properties, commercial forms and uses, together with a discussion of methods of fabrication and finishing. The work is very creditably assembled and is mechanically a good example of book-making art. A splendid index affords means for most convenient use.

Phase Rule Applied

PHASE RULE AND ITS APPLICATIONS. By *Alexander Findlay*. Fifth edition. 300 pages, 158 illustrations. New York: Longmans, Green & Co. Price, $3.50.

Changes in this edition include: revision of the sections on sulphur and phosphorus; a fuller treatment of iron-carbon alloys; more detailed consideration of the graphical methods for representing multi-component systems, particularly Jänecke's methods; emphasis on the importance of the phase rule in the study of mineralogical problems through a discussion of the conditions for the formation of calcium aluminum silicates.

Oxygen

REPORT OF THE OXYGEN RESEARCH COMMITTEE, Department of Scientific and Industrial Research (British). 177 pages, paper bound. Price, 8s. 6d. net. From H. M. Stationery Office, Imperial House, Kingsway, W. C. 2, London.

This research report gives a full summary of the experimental work and conclusions, together with a discussion of the storage of liquefied gases, the manufacture of metal vacuum-walled vessels for liquefied gases, and the transportation of liquefied gases, both in vacuum-walled containers and in high-pressure cylinders.

Practical Electroplating

PRACTICAL ELECTROPLATING. By *W. L. D. Bedell*. Fifth edition, 407 pages, illustrated. Newark, N. J.: Hanson & Van Winkle Co. Price, $3.

Complete practical instructions are given on the arrangement of the elec-

Important Articles in Current Literature

More than fifty industrial, technical or scientific periodicals and trade papers are reviewed regularly by the staff of *Chem. & Met.* The articles listed below have been selected from these publications because they represent the most conspicuous themes in contemporary literature, and consequently should be of considerable interest to our readers. A brief résumé of each article is included in the reference given. Since it is frequently impossible to prepare a satisfactory abstract of an article, this list will enable our readers to keep abreast of current literature and direct their reading to advantage. The magazines reviewed to have all been received within a fortnight of our publication date.

COST COMPARISON IN HANDLING MATERIALS. *Shellman B. Brown.* A description of methods which have been successfully employed for comparing the cost of handling materials by hand and by machine. *Management & Administration*, November, 1923, pp. 611-616.

ORDNANCE INDUSTRIAL MOBILIZATION. *Major-General C. C. Williams.* An exposition of the system being established by the War Department to assure proper ordnance supply in war time. *Mechanical Engineering*, November, 1923, pp. 627-631.

THE CHEMICAL WARFARE SERVICE—ITS ACTIVITIES AND ACHIEVEMENTS. A review of the work performed to date by this division of the U. S. Army which is so fundamentally interesting to chemical engineers. *Mechanical Engineering*, November, 1923, pp. 643-646.

WASTE IN THE SULPHITE INDUSTRY. *O. L. Berger.* A brief review of the following items as affecting the industry: wood, chemicals, steam, power and labor. *Paper Trade Journal*, Nov. 1, 1923, pp. 49-51.

THE GERMAN RUBBER INDUSTRY. A summary of the status of the rubber industry in Germany with a discussion of its extent, location, leaders, etc. *India Rubber World*, Nov. 1, 1923, pp. 88-90.

THE EFFECT OF MASS ON HEAT-TREATMENT. *R. S. Gosrow.* The heating and cooling of nickel-chrome steel forging and their physical properties as a result of heat-treatment. *Forging-Stamping-Heat Treating*, October, 1923, pp. 447-449.

COLLOID CHEMISTRY IN STEEL PRODUCTION. *H. W. Gillette.* Dirty steel is unreliable, especially in resisting fatigue. Present methods tend to destroy colloidal suspensions, but they produce only relatively clean steel. *Forging-Stamping-Heat Treating*, October, 1923, pp. 451-453.

LA FABRICATION INDUSTRIELLE DE L'HYDROGENE. *Captain Max Verneuil.* A discussion of the process of making hydrogen from water gas by catalysis and according to the process of the Société l'Oxhydrique. *Le Génie Civil*, Oct. 13, 1923, pp. 340-346.

SPECIFIC HEAT OF COAL AND ITS RELATION TO COMPOSITION. *G. Coles.* A brief abstract indicating that the specific heat of British coals lies in general between 0.2 and 0.4, according to the amount of water contained. Various classes of coals can be grouped according to specific heat, when all are calculated on water- and ash-free basis. *Gas Journal*, Oct. 3, p. 47.

TEMPERATURE AND CHARPY IMPACT VALUE. *F. C. Langenberg.* An investigation of the effect of temperature on the impact strength of steels of varying composition, including stainless steels. *Iron Age*, Nov. 1, 1923, pp. 1170-1172.

troplating shop, the installation of the equipment, the preparation of plating solutions as well as the best methods for conducting the plating, polishing, buffing and lacquering operations. The thorough, logical treatment will make the book invaluable to the beginner and there is also much material that will be of interest to the experienced electroplater.

Student Helps

LABORATORY DIRECTIONS IN INORGANIC CHEMISTRY. By *Alexander Silverman*, head, department of chemistry, University of Pittsburgh. Second edition, revised, 55 pp., loose-leaf style. New York: D. Van Nostrand Co. Price, $1.25.

INORGANIC TYPE FORMULAS AND THEIR RELATIONSHIPS. Compiled by *Herbert O. Smith*. 6-page leaflet. New York: D. Van Nostrand Co. Price, 15c.

AN OUTLINE FOR QUALITATIVE ANALYSIS. By *Herbert O. Smith*. 4-page leaflet. New York: D. Van Nostrand Co. Price, 15c.

ORGANIC CHEMICAL TRANSFORMATIONS. Compiled by *L. A. Bigelow*, Brown University, and *Kurwin R. Boyes*, American Gas Association. 4-page chart. New York: D. Van Nostrand Co. Price, 20c.

COAL PRODUCTS CHART. Prepared by *Alexander Lowy*, professor of organic chemistry, University of Pittsburgh. 2-color chart, 11x17 in. New York: D. Van Nostrand Co. Price, 15c.

Calendar

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, seventy-fifth anniversary meeting, University of Cincinnati, Cincinnati, Ohio, Dec. 27 to Jan. 2.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, winter meeting, Washington, D. C., Dec. 5 to 8. Headquarters at the Willard Hotel.

AMERICAN PETROLEUM INSTITUTE, fourth annual meeting, Statler Hotel, St. Louis, Mo., Dec. 11 to 13.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, annual meeting, New York City, Dec. 3 to 6.

AMERICAN SOCIETY OF REFRIGERATING ENGINEERS, annual convention, New York City, Dec. 3 to 5.

ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS, thirty-ninth annual convention, Washington, D. C., Nov. 19 to 21.

COAL MINING INSTITUTE OF AMERICA, annual meeting, Pittsburgh, Pa., Dec. 19 to 21.

FEDERATED AMERICAN ENGINEERING SOCIETIES, annual meeting, Washington, D. C., Jan. 10 and 11, 1924.

FRANKLIN INSTITUTE, annual meeting, Philadelphia, Jan. 16, 1924.

NATIONAL ASSOCIATION OF PRACTICAL REFRIGERATION ENGINEERS, fourteenth annual convention, Memphis, Tenn., Dec. 12 to 16.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING, Grand Central Palace, New York, Dec. 3 to 8.

NEW JERSEY CLAY WORKERS' ASSOCIATION AND EASTERN SECTION AMERICAN CERAMIC SOCIETY, annual meeting, New Brunswick, N. J., Dec. 19.

NEW YORK SECTION AMERICAN ELECTROCHEMICAL SOCIETY, Rumford Hall, Chemists' Club, New York, Nov. 16.

PORTLAND CEMENT ASSOCIATION, New York, Nov. 19 to 21.

POWER AND MECHANICAL ENGINEERING NATIONAL EXPOSITION, Grand Central Palace, New York, Dec. 3 to 8.

SOCIETY OF AUTOMOTIVE ENGINEERS, annual meeting, simultaneously with the Detroit Automobile Show, General Motors Bldg., Detroit, Mich., Jan. 22 to 25, 1924.

Men in the Profession

D. P. BENNETT has been elected president of the Pittsburgh Steel Co., Pittsburgh, Pa. E. H. BINDLEY has been elected a vice-president of the organization.

R. M. BIRD, engineer of tests of the Bethlehem Steel Co., Bethlehem, Pa., gave an informal illustrated talk covering his recent work with copper steels at the Washington Chapter of the American Society for Steel Treating, Nov. 2.

G. S. BROWN, president of the Alpha Portland Cement Co., Easton, Pa., will deliver a lecture on the subject of "The Cement Industry" early in the coming year before the members of the Princeton Engineering Association, Princeton University, Princeton, N. J. ERNEST HOPKINSON, vice-president of the United States Rubber Co., New York, has also accepted an invitation to speak before the organization at a later date on the subject of "The Rubber Industry."

W. H. COGHILL, who is studying the problems of the zinc industry in the mid-continental region, is in Washington conferring with Dr. Oliver Bowles, of the Non-Metallic Experiment Station, in regard to the possibilities of adapting ore-dressing methods to the non-metals.

F. A. DONAHOE, of the Refractories Manufacturers' Association, was in Washington last week conferring with Bureau of Mines officials as to cooperative research work.

W. H. EISENMAN, national secretary of the American Society for Steel Treating, spoke before the Washington Chapter, Nov. 2, on the recent accomplishments and future plans of the society.

EDWARD EPSTEIN, chemist at the du Pont Fibre Silk Co.'s plant at Buffalo, N. Y., was seriously injured while at work in the laboratory, Nov. 2, when a retort of chemicals flared up, badly burning his face.

D. R. LAWSON, of the research department of Brunner, Mond & Co., Ltd., of England, was a visitor in Washington last week.

T. D. LYNCH gave an illustrated talk on "Heavy Forging" at the meeting of the Washington Chapter of the American Society for Steel Treating, Nov. 2.

JAY SMITH, assistant laboratory instructor at Grove City College, Grove City, Pa., was recently overcome with fumes of hydrogen sulphide while engaged in experimental work, and was rendered unconscious. He is now on the way to recovery.

ALEXANDER WILLIAMS, JR., secretary of the American Chemical Society committee on prize essays, gave an interesting address before the members of the Rotary Club, Boston, Mass., at their luncheon at the local City Club, Oct. 31. He spoke of the importance of the chemical industry to those outside of its immediate sphere, and discussed the prize essay competition.

J. WIRT WILLIS, vice-president of the New Castle Leather Co., Wilmington, Del., was elected chairman of the Glazed Kid Division of the Tanners' Council of America, at its meeting at Philadelphia, Pa., on Oct. 30. He has been connected with the New Castle company since its time of inception in 1909, and vice-president since its incorporation in 1917.

Obituary

WILLIAM L. F. HARDHAM, president of the Philo-Hay Specialties Co., Newark, N. J., manufacturer of chemical products, died at his home on Oct. 16, of self-inflicted injuries.

ALBERT REID LEDOUX, a past president of the American Institute of Mining and Metallurgical Engineers and honorably known for many years to the members of the professions it represents, died at his country home at Cornwall-on-Hudson, N. Y., Oct. 25, in his seventy-first year.

WILLIAM J. LLOYD, general superintendent of the West Lynn works of the General Electric Co., died suddenly Oct. 28 in an automobile as he and friends were entering the grounds of the Tedesco Country Club.

Prof. ERNEST BOYCE STUART, 76 years old, scientist and professor of chemistry at Northwestern University until a few weeks ago, died Oct. 31, following a paralytic stroke. He was a native of Vermont and enlisted at the age of 15 in the Civil War.

WILLIAM F. WENDT, 65 years old, founder and former president of the Buffalo Forge Co. of Buffalo, N. Y., and prominent for many years in local business and political affairs, died at his home in Buffalo, Oct. 30. He was a brother of Henry Wendt, now president of the Buffalo Forge Co. Mr. Wendt was born in Buffalo. He continued as president of the company which he was instrumental in starting until 1916, when he retired. He was also president of the George L. Squier Manufacturing Co., the Buffalo Steam Pump Co. and the W. F. Wendt Publishing Co., which issued *La Hacienda*, printed in Spanish and circulated in South America, and the *American Blacksmith*. He retired from the publishing company 2 years ago.

News of the Industry

Summary of the Week

Merger of prominent French chemical companies expected to be completed by end of year.

Sharp declines in price have brought quotations for prussiates to the lowest levels of the year.

New uses for silver in industry and commerce are predicted.

Refusal of Chilean Government to grant concession to railway company affects transportation facilities for nitrate.

Report of Brigadier-General Fries indicates varied work of Chemical Warfare Service extending the use of war-time gases to many peace-time uses.

Tariff Commission conducts hearings on oxalic acid, barium peroxide and barbital.

Peru will develop guano consumption by restricting imports of soda nitrate.

Imports of dyes in October show material increase over those of preceding months.

Decision is rendered against the French Battery & Carbon Co. in the suit charging patent conspiracy brought by the C. F. Burgess Laboratories.

Professor James indicates growth of dyestuff industry and predicts future supremacy of this country in dyestuff manufacture.

James Traces Dye Development Here and Predicts Supremacy Over Germany

Points Out Early Difficulties—Influence of Textile Manufacturers—Improvement and Complete Independence Only a Question of Time

AMERICA'S supremacy over Germany in the dye industry of the world is a matter only of a few years, declares Prof. J. H. James, head of the department of chemical engineering at Carnegie Institute of Technology, Pittsburgh. "This probability," says Professor James, who has made a study of the dye industry, "is evidenced by the fact that the United States now produces about 93.5 per cent of the dyes actually consumed in this country. While it is still necessary for this country to import the remaining 6.5 per cent from Germany and Switzerland, which percentage represents only the latest developments of dye manufacture in these two countries, it is clear that America's ability to shift for herself in the dye industry is an indication that eventually she will supply most of the dyes to the world."

In tracing the scientific development of the dye industry in this country and the remarkable progress it has made since 1914, when the war shut off the supply coming from Germany, forcing America to shift for itself for its dyes, he said: "Germany was the home of the dye industry and has done more scientific research along these lines than any other country on the face of the globe up to the time of the war.

"From 1870 to 1914, which is commonly referred to by students of industrial chemistry as the 'golden age' of German dyestuff manufacture, there took place the most wonderful development in chemical manufacture in the history of the world. It was during that period that the German Government extended long-term credits to the firms interested in research work and development of this kind and the manufacture of this product. And it was during that time that Germany made itself known everywhere as the leading dye country of the world.

Less Incentive for Research

"In a new country, like the United States, capital secured greater returns from mine, timber, railroad and steel development, and industrial leaders naturally did not become interested in an industry that required such an outlay for equipment and continued research such as the Germans were putting into their organic chemical manufacturing. In addition, our patent laws relative to foreigners are so framed that an American patent gives the foreigner a monopoly in this country whether he chooses to make the patented product here or not. With cheaper labor, consisting of an abundance of chemically trained men from the universities and technical schools of Germany, conditions were really more favorable there for this kind of manufacturing than in this country, while furthermore our patent laws protected them against competition in this market.

"Before 1914, it must be admitted, the textile manufacturers, who are, of course, the big consumers of dyes, never threw any influence to aid the American chemical manufacturers in their various efforts, legislative and otherwise, that were made to develop an American color industry. As a straight business proposition they figured they could always secure their dyes cheaper from Germany, where this industry was first developed; and the history of American color manufacture up to 1914 is one long record of attempt after attempt followed in practically every case by failure, as there were in 1914 only seven small struggling firms engaged in this line in the United States.

"Now that the war is over, reflecting on Germany's ambition to control the dye business of the world leads one to suspect that the German Government had a sinister motive in gaining supremacy. Control of the dye industry may have been more than an economic measure; for theoretically every chemical plant manufacturing dyes is a potential plant for the manufacture of munitions, since it happens that the apparatus and skilled men used in the first stages of much of the color manufacture can be turned over in a short time to the manufacture of high explosives.

"Soon after the war broke out, with the English blockade in force, the need for dyes became so great that something here was necessary. Chemists became interested in the work, and the manufacture of American dyes was started on a larger scale than had ever been possible before.

"Of course it was poor stuff that was produced at the beginning. That was expected. Colors faded and ran, and

textile manufacturers were up in arms. That was expected, too, but the progress has been steady and consistent, and gradually America is taking its place in the world as a manufacturer of dyes.

Effect of Legislation

"Since 1918 various legislative devices kept out the German dyes until the passage of the tariff bill last year, which insures a stability to the industry for some years to come. It would appear to be the part of wisdom, since a well-developed organic chemical industry is absolutely essential as a part of national preparedness, that the government should see to it that we have at all times all of the encouragement possible given to these firms engaged in this line.

"Furthermore, since the biggest users of colors are the textile manufacturers, it would seem that these men themselves should have engaged long ago in the manufacture of colors, thereby getting them at cost.

"The Pittsburgh district has shown us a similar situation relative to soda ash manufacture. This chemical is essential in glass manufacture. One large plate glass firm many years ago erected its own soda ash plant in Ohio, and in another line of glass manufacture a group of glass men organized a soda ash company which provides all the soda needed by each glass concern holding stock in the alkali company. It is hard to see why the powerful textile group should not have done the same thing in connection with dye manufacture. If they had done this, say back in 1900, there would have been no dye famine in 1914."

Quoting from a recent report of the United States Tariff Commission, Professor James recited figures showing increases in dye production in this country in the last 9 years and corresponding decreases in the average sales prices of the dyes. According to this report, there were in 1914 only seven American firms, that manufactured a total of 6,619,729 lb., valued at $2,470,096. The sales of 87 American firms manufacturing dyes in 1922 totaled 69,107,105 lb., valued at $41,463,790. The average sale price of domestic dyes for 1922 was 60 cents per pound, compared with 83 cents in 1921 and $1.26 in 1917.

In 1914 the imports of dyes were nearly 90 per cent of our consumption, the imports then totaling 45,950,785 lb. The imports in 1922 were 6.5 per cent of our consumption.

Limited Railroad Facilities Disturb Nitrate Interests

Chilean Government Refuses Further Concessions to Railway Company

A report from Valparaiso says that adverse comment is made in nitrate circles there on the rejection by the Chilean Government of the application by the Nitrate Railways Co., Ltd., for the consolidation and renewal of certain concessions in connection with its lines in the northern nitrate area. The company, an English concern, operates, with a capital of £4,200,000, about 642 kilometers of railway, the development of which was made economically possible by the granting of certain concessions for different periods, the earliest of which is nearing its termination. In 1936 a section of the line, extending from Iquique to La Noria, a distance of 67 kilometers, will pass into the possession of the state.

In view of the uncertain future of the railways affected, important negotiations have been carried on for the past year between the Chilean Government and the directorate, the latter being desirous of obtaining authorization for the consolidation and renewal of the concessions and for the raising of tariffs by 25 per cent. In return for these advantages, the Nitrate Railways Directorate offered to invest £1,100,000 in a thorough renovation of the lines and rolling stock, raising the capacity of the daily transport of the railways to 6,000 tons. On a vote in the Senate, however, the concessions were lost by the small margin of one vote.

It is impossible to estimate the effect that this governmental decision will have on the future of the nitrate industry. Nitrate circles evince alarm, chiefly owing to the situation of the producers served by the railway in Tarapaca, who have complained that the present handling capacity of the line is not adequate for a period even of reasonable production. In the event, confidently expected, of a considerable increase in demand for nitrate, the fear is expressed that the transport facilities will not suffice to move the vast accumulations of nitrate on the pampas to the ports. Had the consolidation been granted and the promised million pounds been invested in the improvement of the line, this possibility of paralysis would have disappeared.

W. Lee Lewis to Direct Research for Meat Packers

Dr. W. Lee Lewis, head of the department of chemistry of Northwestern University, has been appointed director of scientific research for the Institute of American Meat Packers, with headquarters in Chicago. The purpose of this division of the Institute's activities is to make a study of the research problems presented by the packing industry. The trustees of Northwestern University have granted Dr. Lewis a leave of absence from Feb. 1, 1924, for a year in order to allow him to devote his time to the organization of this work. This arrangement includes the continuation of the direction of research work under Dr. Lewis on carbohydrates and organic arsenic compounds now being carried on at Northwestern. During Dr. Lewis' absence Prof. Frank C. Whitmore will serve as acting chairman of the department.

"Why a Contract Ain't"

Salesmen's Association of the Chemical Industry Discusses This Important Subject at New York Banquet

The evils of the present contract system, especially as applying to dealings in heavy chemicals, were thoroughly panned at the meeting of the Salesmen's Association of the Chemical Industry which was held at the Builders' Club, New York, on Nov. 7. The attendance of 69 out of a total of 149 members was considered a record one. The routine business of the evening brought out no unusual developments. No action was taken on the proposal which has been made to limit membership.

Ralph E. Dorland, president of the association, prefaced his introduction of the speakers of the evening by pointing out the purposes and possibilities of the organization. That a spirit of helpfulness and constructive criticism rather than of dictation underlies the endeavors of the association was the principal point brought out.

Antagonism in Europe Against U. S.

Conditions in the chemical industries of the Continent were commented upon by Elmer H. Bobst, of the Hoffman-La Roche Chemical Co. In the course of his talk Mr. Bobst stated that it has been his observation in general that the press has exaggerated in depicting the state of affairs. That a feeling of antagonism against American chemical manufacturers has been fostered by our Tariff Commission and other government investigations was his belief. He pointed out that the invasion of the Ruhr has had the natural effect in strengthening the chemical industry in other parts of Europe.

Better Business Spirit Urged

P. S. Tilden, New York sales manager of the F. Swift Gibson Co., and Milton Kutz, sales manager of the Roessler & Hasslacher Chemical Co., were the chief speakers on the topic of the evening, "Why a Contract Ain't." Both talks were entirely informal and both were studded with constructive suggestions. Mr. Tilden brought out the inevitable effect of keen competition in regard to contracts. He showed that the old notion of an ironclad contract has been forced out of existence by such competition, that as a result many concerns now conduct their business on memorandum agreements in place of the old contract. He indicated that a spirit of fair play must dominate sales practice if contract breaking is to be abolished.

That overproduction has much to do with the competition that has brought about the present status of the contract was asserted by Mr. Kutz. He maintained that if principals would be content with doing less business, cutthroat competition might be reduced, profits increased, satisfaction of the buyer built up and a general improvement brought about.

Washington News

German Dyes Offered on Barter Basis

That the German dye industry is reaching out in preparation for the time when it will be better able to compete for world business is indicated by a recent formal proposal to Greece that a certain amount of tobacco would be purchased for German account if that country would arrange in turn for the purchase there of a certain amount of German pharmaceutical products. Similar tenders have been made to other countries. While the exact terms of the proposal have not been revealed, it is assumed that the plan is substantially one of barter. Those who are watching the situation expect to see Germany undertake such bartering on a large scale.

Information has reached this country that certain Italian chemical plants have been absorbed by German interests. This is thought to be a further step in the plan for a close working agreement between the German and Italian chemical industries.

Despite the fact that the German dye makers are willing to dispose of their products practically at cost, they are not making headway in the markets where the United States is prepared to compete. American manufacturers are more than holding their own in China's indigo market. The Germans are supplying only small quantities of that dye. The latest German move in that territory is to put on the market lots of indigo and other colors without reference to their German origin. Only a few years ago the fact that colors were made in Germany was their best recommendation. It is significant of the progress that has been made since in other countries that the identity of the German colors is being concealed.

Further evidence of waning German prestige is had in the efforts being made by Belgian interests to purchase certain basic intermediates in this country.

Rubber Imports Rising

Foreign control of crude rubber supplies or not, imports of that commodity during the first three quarters of this year reflected substantial advances over a year ago, it is disclosed in the trade reports of the Commerce Department.

During the 9 months ended with September a total of 552,000,000 lb. of rubber was imported, as compared with 471,000,000 lb. for the corresponding period of 1922. Imports from the British East Indies for the 9 months amounted to 363,000,000 lb., against 338,000,000 lb. for the same period last year, and shipments from the Dutch East Indies aggregated 86,000,000 lb., compared with 68,000,000 lb. during the 9 months ended with September, 1922.

New Uses for Silver Will Be Found, Is Belief

Director Bain of Bureau of Mines Seeks Suggestions in Discovering Such Uses—Industry Much Interested

Judging from the communications that have reached the Bureau of Mines since the suggestion that technical research be undertaken in an effort to establish new or increased uses of silver, there is general support in the silver-mining states for such an endeavor. While large sums of federal money have been expended on research intended to aid the agricultural or manufacturing industries, it is a fact that little governmental research has been done on silver. It also is pointed out that the industry itself has been particularly lethargic in that particular. The greatest enterprise has been shown in connection with the treatment of silver ores, but comparatively little work has been done in an effort to widen the use of the product.

There is general confidence that new means will be found to capitalize some of the very remarkable properties which silver possesses. There is hope that its superiority over all metals as a conductor of electricity can be applied in some way that will call it into use in improving radio equipment or other electrical appliances. More advantage can be taken, it is believed, of its unusual properties of malleability and ductility. Its ability to absorb oxygen opens another field. A small portion of silver added to aluminum is said to impart to that metal all the decorative properties of nickel without the disadvantages that go with plating. Silver enjoys a prestige that has been accumulating since prehistoric days. In that connection it may be mentioned that one of the archæological treasures is a record of the establishment in 3000 B.C. of a ratio under which silver was to be used for current payments.

Director Bain, of the Bureau of Mines, is anxious to receive further suggestions in connection with this study. He calls attention, however, to the fact that the Bureau of Mines is engaging only in the technical side of the problem.

Commerce Department Exhibit Feature at Boston Show

The outstanding feature of the Boston textile show is admitted to have been the chemical exhibit of the Department of Commerce. The usual conception of the function of the Chemical Division is that its sphere of activity is confined to the export trade and the producing end of the industry. In this instance the division carried its message to the consumers of dyes. The exhibit acquainted consumers with the wide range of colors now made in this country. In certain specific cases textile manufacturers learned for the first time that colors which they had been very anxious to secure were available at American plants.

Other features of the exhibit emphasized how chemical processes had made it possible for supplies of raw material to become available quickly enough to keep pace with the rapidity of manufacture by modern machinery. The bleaching process, for instance, which formerly required 7 days of sunshine, now is accomplished in a chlorine bath in 1 hour.

The large crowds that assembled at each recurring "show" staged at the chemical exhibit were told in detail how the Department of Commerce scours the world for the necessary raw materials for our industries and helps find markets for the finished products manufactured here.

This exhibit is the conception of T. W. Delahanty, acting chief of the Chemical Division. The success which accompanied its display at Boston may lead to its being reproduced at other important conventions.

Kuhlmann Interests Absorbs French Dye Industry

The foreseen combination between two important French chemical industries—Manufacturers de Produits Chimiques du Nord (Etablissements Kuhlmann) and the Compagnie Nationale des Matières Colorantes et Produits Chimiques—has just been completed. Henceforth the two concerns will operate under the registered name of Etablissements Kuhlmann, with a capital of 150,000,000 francs. There will be two distinct administrative heads. The advantages of the combination will be the concentration under one responsible financial and commercial machine of all the process of manufacture and distribution of its varied line of chemical products, ranging from mineral acids, dyestuffs and intermediaries to pharmaceutical products.

The combination will result in important reductions in overhead costs of the conduct of the businesses as formerly operated, with manufacturing processes as well as with distribution and sales. Furthermore each concern thus eliminates a possible competitor and finds itself better armed to meet outside and home competition as well. It is regarded likely in Paris that this combine is but the forerunner of others of a like nature in many industrial enterprises in France. Obviously the procedure is one of economic necessity. The Etablissements Kuhlmann as now reconstructed is one of the most powerful chemical industries of France, though by no means giving the large profits hitherto enjoyed by the famous Saint Gobain Co. The latter concern has a restricted capital of something like a third of that of the new organization, with which it directly competes.

Chemical Warfare Service Active on Peace-Time Problems

Report of Brigadier-General Fries to War Department Indicates That Insect Pest Extermination, Fumigation Developments and Poison Gas Defence Are Receiving Attention

THE Chemical Warfare Service faced the year 1923 with such a serious cut in its appropriations as to necessitate an entire revision of its operations. In addition to the money available the service was seriously handicapped by the necessary reduction of officers under the provisions of the appropriation bill. Many officers, somewhat beyond their rank in years and with high scientific attainments, took advantage of the provisions of the law to resign and associate themselves with private enterprises.

Although working at a disadvantage, the Chemical Warfare Service made noteworthy progress in many of the projects undertaken and practically all of these projects have been developed not only for their military value but for their commercial and everyday use.

In order to grasp the peace-time value of the Chemical Warfare Service of the army, it is necessary to realize that chemical warfare materials are not strange and unusual, as so often represented. They are among the commonest and most useful substances in everyday use. In every city in the United States and every civilized land many of them are used on an enormous scale.

One project has been carried on to assist the Bureau of Agriculture to develop the use of war gases as insecticides; one angle of this project is the extermination of locusts, which are a curse to the agricultural interests of the Philippine Islands. In this the Chemical Warfare Officer, Philippine Islands, is actively assisting the Bureau of Philippine Agriculture.

Anti-Fouling Paint

In co-operation with the Navy Department, Department of Commerce and various scientific organizations there is being developed an anti-fouling paint for the protection of ships' bottoms. Also a study is being made of the preservation of marine piling from the teredo, limnoria and other marine borers.

The Chemical Warfare Service has furnished materials for tests conducted by the Weather Bureau, Department of Agriculture, to determine the effectiveness of smoke clouds in preventing night cooling, for the purpose of protecting orchards from frost. The service has also been called upon to investigate the problem of screening large areas by smoke.

The Chemical Warfare Service in conjunction with the Public Health Service has developed a new method for fumigating ships with very little danger to the personnel engaged in this work. To protect the United States against the importation of disease from foreign countries the Public Health Service fumigates all such ships. For example, the Public Health Service is constantly at war against typhus and bubonic plague; these diseases are carried by the body louse and the flea respectively. The louse makes himself at home in clothing and fabrics generally, while the flea finds both his home and transportation upon the rats which infest all ships. To destroy the rat and his cargo and to exterminate the louse requires an agency of superpower but at the same time harmless to the most delicate fabric and to metal. Hydrocyanic acid gas has been the most commonly used for this purpose due to its effectiveness, but the danger to the personnel using it has been very great. It has no taste, very little odor and produces very little discomfort to a person inhaling it, and therefore gives no warning of its presence.

The Public Health Service asked the Chemical Warfare Service for assistance in reducing the danger in the method then used, which had resulted in many fatalities. The combination of a tear gas with the hydrocyanic acid was first tried. The presence of the tear gas was found to give ample warning of its deadly associate, but proved to be so persistent as to cause delay in returning the ship to duty. The service then developed the use of another tear gas which is itself deadly in effect but which dissipates rapidly and, most important of all, its presence in one-eighth of the amount necessary to injure human beings is intolerable in a harmless way. This process has been perfected and is rapidly being put into use. This material is effective on any vermin, rodents or insects and can be used for storehouses, dwellings, kitchens, etc. This gas can and probably will be used commercially in the killing of the weevil that destroys grain of all kinds while stored in elevators, and it will do this without creating a fire hazard or causing danger to human life.

Work on Boll Weevil

One of the greatest economic losses suffered by the United States each year is the damage to growing cotton by the boll weevil. The Chemical Warfare Service does not claim that it can certainly solve this problem, but so far as can be now seen the Chemical Warfare Service will be of considerable assistance in its solution.

One of the interesting uses of Chemical Warfare agencies, tried out with success, is against robberies of banks, mail trucks, vehicles carrying valuables, and pay-roll messengers. So instantly effective are the gases used for this that the robber can be put out of action before the robbery can be consummated.

The Service's development of defence against gas has kept pace with that of its offensive use. Among the developments are some of everyday interests; one being a material which is a complete protection against the deadly carbon monoxide, which, as every one knows, has killed many people while working in too tightly closed garages and which is also found in ordinary illuminating gas. Another substance is a protection against ammonia fumes. The Chemical Warfare Service has also worked out a method for putting a very fine film of a material on eyeglasses and even automobile wind shields, making them far easier to see through in misty and rainy weather.

Therapeutic Application of Gas

Among the most interesting phases of the Chemical Warfare Service is the study of gas from the medical point of view. For instance, information has been gathered during the past year which goes to prove that the after effects of warfare gases are practically nothing, and, strange as it may seem, gases similar in effect to warfare gases have been proved to have a very great value in the treatment of disease, notably the respiratory diseases.

This example of similarity of methods of manufacture of both deadly poisons and harmless everyday necessities is further illustrated by the little known fact that one of the processes for making indigo is the same in the first three of the necessary operations in making the celebrated war-time mustard gas.

Increased Imports of Dyes in in October

The imports of coal-tar dyes for October totaled 267,556 lb., with an invoice value of $257,084. The following table shows the monthly imports through the port of New York for the year 1923:

Month	Lb.	Value
January	179,309	$185,344
February	191,709	199,699
March	312,809	301,436
April	242,022	256,751
May	261,869	292,340
June	247,174	257,803
July	144,687	142,428
August	178,164	194,164
September	124,665	128,544

The five dyes leading in quantity imported were Xylene light yellow, Indanthrene green B, Alizarine rubinol, Alizarin red and Indanthrene blue B.C. Of the total quantity imported in October, 1923, 31 per cent came from Switzerland, 29 per cent from Germany, 23 per cent from France, 11 per cent from Italy, 4 per cent from England and 2 per cent from other countries.

The imports of synthetic aromatic chemicals for October totaled 3,533 lb., with an invoice value of $10,372. The imports of medicinals, photographic developers and other coal-tar chemicals for October totaled approximately 29,700 lb., with an invoice value of $21,749, and the imports of color lakes totaled 1,220 lb., with an invoice value of $519.

Production Costs of Oxalic Acid Figure in Tariff Hearing

Commission Also Conducts Hearings on Barium Peroxide and Barbital

INVESTIGATION by the Tariff Commission into costs of production of oxalic acid under the provisions of the flexible tariff came to an end Nov. 5 with a public hearing at which representatives of the two applicants for a change in the rate of duty, one seeking an increase and the other a decrease, testified. Both sides waived final arguments and briefs, so that the case now is up to the commission for report to the President.

The Victor Chemical Works, of Chicago, applied for an increase of 50 per cent in the 4 cents per pound duty on this chemical. R. F. Greeff & Co., Inc., of New York, selling agent for the Fabriek van Chemische Production, Holland, applied for a decrease in the duty.

A. H. Kochs, president of the Victor Chemical Works, testified that under normal conditions Germany is the principal competitor in oxalic acid and that costs of production are so much lower in Germany that the product can be manufactured and sold in the United States, duty paid, at less than the cost of production in this country. He asserted that if domestic plants were operated at capacity they could sell at the present market price—around 12 cents per pound—by reason of reduction in overhead, but that present costs of production are above this figure. J. T. Webster, secretary of the company, testified regarding cost sheets which were introduced in evidence.

M. R. Bruce, representing Greeff & Co., testified that the costs of production of the plant in the Netherlands are so high that its product cannot be sold profitably in the United States after paying the present duty of 4 cents per pound.

The annual consumption of oxalic acid in the United States is approximately 6,000,000 lb. and the Tariff Commission's staff reported that domestic plants had a total capacity equal to the demand.

The information compiled by the U. S. Tariff Commission placed the domestic production of oxalic acid by four concerns at 3,973,807 lb., in 1922. The normal annual domestic consumption is estimated to be between 6,000,000 and 8,000,000 lb., which is slightly more than the consumption figures as indicated by statistics of imports and production in recent years, but agrees with those prior to the war. The total present domestic capacity is about 6,000,000 lb. annually, which will supply nearly all, if not the entire, domestic consumption.

For several years prior to the war imports of oxalic acid amounted to from 5,800,000 to 7,800,000 lb. annually. Domestic production during that period was negligible, but increased during and after the war. Imports of oxalic acid decreased to a minimum of 456,698 lb. in 1919, and from 1920 through 1922 have been from 1,000,000 to 1,789,000 lb. annually. General imports for 6 months of 1923 amounted to 1,581,069 lb., indicating a considerably larger consumption of the imported article this year as compared with other years since 1914.

The following table gives by countries the quantities of oxalic acid imported through the port of New York during the first 6 months of 1923, together with the unit price f.o.b. European port:

Country	Quantity (Lb.)	Unit Value F.O.B. European Port
England	11,175	$0.0899
Germany	419,350	0.0552
Holland	275,978	0.0888
Norway	152,334	0.0932

Foreign Production

The chief foreign producing countries are Germany and the Netherlands. There are smaller factories in Norway, Denmark and England.

In Germany there are at present two factories, Elektrochemische Werke C.m.-C.H., at Bitterfeld, Berlin, belonging to the Griesheim Elektron Co., and Rudolph Koepp & Co., in Oestrich-am-Rhein. German exports of oxalic acid for the fiscal year ending April, 1922, were 3,157,648 lb., which is equal to a daily production of slightly over 5 tons on a basis of 300 working days in the year. In the Netherlands there is only one plant, located at Vondelingenplaat, 7 miles from Rotterdam.

The German and Dutch plants all use the sodium formate process. The Norwegians formerly used the sawdust-potash process, but this has been largely superseded by the formate process. Norwegian exports of oxalic acid in 1921 were 271,894 lb., which is probably only slightly less than the production. During the first 6 months of 1923 imports of oxalic acid through the port of New York from Norway were 152,334 lb.

With regard to costs of production the commission reported that costs were obtained from two domestic companies, the production of which represented 78.5 per cent of the domestic production for 1922, and from one Dutch company. These costs cannot be published without revealing the figures for individual companies.

A comparison of domestic and foreign costs of production as obtained tends to show that the costs in the Netherlands are substantially lower than the domestic. However, when the present duty is added to this foreign cost this difference is practically eliminated.

Conflicting views as to the effect of the 4 cents per pound duty on barium peroxide were presented to the Tariff Commission Nov. 9. Two applications under the terms of the flexible tariff were submitted affecting this chemical, one by the J. H. R. Products Co., Willoughby, Ohio, requesting an increase in duty and the other, by John Bene & Sons, Inc., Brooklyn, requesting a decrease.

The Ohio company produces barium peroxide for the open market and also for its own consumption in the manufacture of peroxide of hydrogen. The Brooklyn company manufactures peroxide of hydrogen, purchasing both foreign and domestic barium peroxide for this purpose.

Each of the applicants contended that it would be forced out of business unless the tariff duty were increased or decreased, respectively.

Germany is the principal foreign competitor in barium peroxide, but imports also are received from England and France. The domestic consumption is about 4,000,000 lb. annually. The Tariff Commission's experts reported that the capacity of domestic plants is equal to meeting the demand.

Hearing on the application of the Abbott Laboratories, Chicago, for an increase in the duty of diethylbarbituric acid (barbital) under the terms of the flexible tariff was held by the Tariff Commission Nov. 7. No opposition appeared.

The only witnesses at the hearing were Alfred S. Burdick, president, and E. H. Ravenscroft, vice-president, of the Abbott Laboratories. They testified that the duty of 25 per cent fixed in paragraph 5 of the tariff act of 1922 is inadequate to protect the domestic industry against competition from Germany, owing to a wide difference in costs of production.

The patent on barbital has expired and its manufacture is open to any American company. Only two companies, however, are in production of this chemical, which is the same as that sold under the term verinol, the trade name of the German product, these being the Abbott Laboratories and the American Bayer Co., of Rensselaer, N. Y. The Antoine Chiris Co., of New York City, formerly produced barbital, but has discontinued its manufacture.

A.C.S. Convention Committee Named

W. D. Bigelow, director of the National Canners' Association Laboratory, Washington, will be general chairman of the American Chemical Society convention committee for the spring meeting April 21 to 25, 1924, in Washington. W. M. Clark, of the Hygienic Laboratory, is vice-chairman. The subcommittee chairmen, who make up the general convention committee, are as follows: Atherton Seidell, Finance; L. I. Shaw, Registration; H. E. Howe, Publicity; H. C. Fuller, Hotels and Transportation; R. S. McBride, Entertainment; Guy Clinton, Meeting Rooms; L. H. Adams, Excursions, and Mrs. H. E. Howe, Ladies.

Burgess Laboratories Wins Battery Suit

Decision Establishes Precedent as to Patent Rights When Ideas Are Stolen

After remaining in the courts since June, 1921, the suit of the C. F. Burgess Battery Co. and the C. F. Burgess Laboratories against the French Battery & Carbon Co. of Madison, Wis., was ended with the decision handed down by Judge Stevens on Nov. 3. The contention of the Burgess companies that a conspiracy was entered into by the French Battery & Carbon Co. was upheld. The co-defendants, James B. Ramsay and O. E. Ruhoff, president and vice-president respectively of the latter company, were found guilty of the charge that they had conspired "to wrongfully procure the inventions and trade secrets of the Laboratories and to appropriate them to the use and benefit of the French company."

For several years previous to 1916, O. E. Ruhoff was intimately connected with the dry battery research work at the Burgess Laboratories. When the French company established its own laboratories in that year he left the Burgess Labs to become technical director of the new establishment. Beginning in the summer of 1919, numerous patents along battery lines were issued to Ruhoff and assigned to the French Battery & Carbon Co. Many of these patents were conceived by Ruhoff while with the Burgess company.

Since the court found a wrongful appropriation of the inventions and trade secrets of the Burgess Laboratories as a result of the conspiracy charged, Judge Stevens held that eight patents taken out by Ruhoff and assigned to the French company will have to be returned. A ninth patent was declared void because an employee of the French company acted as a dummy in securing the patent, which was conceived at the Burgess Laboratories. One important decision was with regard to a patent covering the use of chromate in a dry cell. All rights on this revert to the Burgess company and a heavy royalty must be paid for the use of it by the French company. All charges of the litigation must be paid by the defendants.

High Points in Decision

Of much interest is the decision of Judge Stevens relative to Ruhoff's employment by the Burgess Laboratories. He holds that Ruhoff was under contract to assign all inventions and conceptions of inventions to the Laboratories made during his period of employment. The ruling in part was as follows: "It was Mr. Ruhoff's business to discover improvements on the process under investigation. He was given full opportunity to test out all improvements which suggested themselves to his mind. One of the returns which the Laboratories had for the money it invested in its plant and in the time of its workers was the ownership of the inventions made or conceived by these workers. The protection sought was a fair one viewed from the standpoint of the relationship of the parties. . . . The question here is whether the invention [any one in question] was 'made or conceived' during the life of Mr. Ruhoff's contract with the Laboratories. . . If the contract [under which workers were employed] required that an invention should be actually or constructively reduced to practice in order to come within its terms, any laboratory worker could appropriate to himself the results of his discoveries while at the Laboratories by postponing the reduction to practice till he had severed his connection with the Laboratories."

News in Brief

A Brazilian fish industry may result if plans announced by Assistant Trade Commissioner B. H. Noll mature. Although the entire project is still in the process of organization, the promoters are desirous at present of lining up equipment for refrigeration, making oil and fish meal, glue and tin cans, cooperage and manure.

Calcium cyanide as an aid in combating chinch bugs was discussed at a meeting of entomologists of four states in Kansas City, Oct. 29. It appears from the work done by the Kansas and Missouri agricultural colleges that the use of this salt is effective in preventing bugs traveling into growing grain in warm weather.

Wisconsin forests are likely to be protected. Paper mill men in that state in co-operation with the American Paper & Pulp Association are vigorously pushing the Wisconsin Forest Protective Association, which was formed on Oct. 23. The new organization has the entire approval of the leading state officials.

The boll weevil apparently does more damage than it has been credited with in the past. Workers in the North Carolina Agricultural College have found that the cotton boll weevil is responsible for the spread of cotton anthracnose of boll-rot from plant to plant in the fields. This disease causes a great loss which has not been previously charged against this pest.

To develop adequate power at the Wilson dam of the Muscle Shoals, Ala., project, Secretary Weeks has recently recommended that the budget bureau approve a $2,000,000 appropriation which would double the capacity of the dam by increasing the power units to be erected there from four, as was originally contemplated, to eight.

Cereal chemists in the vicinity of Kansas City have recently formed an organization to provide a common meeting ground. The first bimonthly meeting was held on Oct. 25, at which time the subject of protein and its accurate analysis was discussed.

Linseed Oil Is Quiet in Antwerp Market

Stocks Small and Consumption at a Minimum—Holland Buys Seed for German Account

The Antwerp oil market during September, was affected by the sudden increase in the value of the Belgian franc, followed by as sudden a fall. These extraordinary fluctuations were due to the political situation in Central Europe, particularly in the Ruhr, according to a report from Consul C. E. MacEachran of Antwerp.

Prices for linseed oil at the beginning of the month were the same as those ending the month of August. During the remainder of the month, however, the great fluctuations in exchange affected the market to such an extent that buyers were very cautious. For the first half of the month the volume of business was small, but the tendency was firm, in sympathy with foreign markets. Owing to the firmness in oil seeds, the oil market followed this movement, and increased about £2. This increase in foreign currency did not materially affect the market in Antwerp, owing to the increase in value of the Belgian franc, so that quotations were maintained. It had another effect, however, on the Dutch and British markets, where the exchange is not much reckoned with, and the increase in business was large. Local business was small, as speculators were taking more interest in foreign markets. Prices in Belgian currency were maintained, and the second week ended with spot prices at 380 francs.

Prices Sink Rapidly

During the second half of the month, owing to the regular and continuous increase in the value of the Belgian franc and quieter news from foreign markets, prices went down rapidly. Sellers were more pressing, but buyers were very cautious, and business was confined to speculation coverings only. The demand for consumption is next to nil. This situation prevailed up to the end of the month, but business was of a small volume owing to the fluctuations of exchange.

The improvement in linseed was very welcome after such a bad season, and prices increased by about £1, with relatively many transactions done. This was caused principally by the fact that Holland was purchasing rather large quantities on Germany's account. The demand for consumption was small, as crushers are not buying, owing to the high price. This would give no profit to the crushers, who bought only the quantities strictly necessary, being afraid to commit themselves in large purchases, as the rates of exchange are too unsettled. The small stocks at the beginning of the month are being liquidated, and as the arrivals were very small, at the first large demand there will be a lack of merchandise and higher prices will very likely be asked.

Chemical Exports in September Show Increase of 24 Per Cent Over Last Year

Coal-Tar Chemicals Prominent in Foreign Trade—Reduced Sales of Industrial Chemicals in Third Quarter

THE exports of chemicals and allied products from the United States for the 9 months January-September, 1923, had an aggregate value of $113,650,712, an increase of 24 per cent over the corresponding period of 1922 and an excess over the total exports for the 12 months of 1922. The exports of $38,525,690 for the third quarter, although surpassing those for the first quarter, were below those for the second quarter. The figures for September ($12,015,658) represented an increase of 14 per cent over September, 1922, and an increase of less than 1 per cent over August, 1923, but a decrease from June and July, 1923.

Coal-Tar Products Advance

Foreign sales of coal-tar products valued at $3,439,189 during the third quarter continued the favorable increase evident throughout this year and represented a gain of 73 per cent over the third quarter of 1922. An expansion of 69 per cent was made for the 9 months of 1923 over 1922 as shipments worth $9,754,248 were sent abroad from January-September, 1923. However, the exports for September were the lowest for any one month during the current year. This may be due to the fact that the figures for July were so exceedingly high.

More coal-tar colors, dyes and stains ($1,569,734) were exported during the third quarter of 1923 than during either of the preceding quarters and one-third more than during the corresponding period of 1922. In the January-September, 1923, period there was sent abroad 13,728,109 lb., valued at $4,279,280, an increase of 55 per cent in value and of 160 per cent in quantity over the January-September, 1922, period.

Industrial Chemicals

Although the exports of sulphuric acid have shown a tendency to recovery and surpassed the shipments made during the third quarter of 1922, the figures for the 9 months of 1923 (6,996,404 lb., $142,007) were less than those for 1922. Even though the shipments of wood and denatured alcohol which were made in the third quarter of 1923 were below those for the same period of 1922, the total of 1,001,281 gal., $1,054,410, for the 9 months represented a substantial expansion over 1922. Looking at September alone, there was a decrease of 31 per cent in quantity but an increase of 24 per cent in value.

Reductions were made in the foreign sales of ammonia and ammonium compounds, calcium carbide, bleaching powder, copper sulphate, potash chlorate and potash bichromate during the past quarter and during the three quarters as related to 1922.

The very small amounts (222,772 lb., $8,910) of acetate of lime which were sent abroad in September characterized the foreign trade of that commodity. The sales declined in quantity from 22,884,395 lb. in January-September, 1922, to 18,843,463 lb. in January-September, 1923, but improved in value from $457,130 to $686,142. On the other hand, the foreign demand for formaldehyde during September was the largest for any single month throughout the year and equalled one-third of the total quantities shipped in 1923.

Nearly one-third more in value of aluminum sulphate left this country in the 3 months July, August and September, 1923, than in the July, August and September, 1922, which was also an advance over the first 3 months of 1923, but a decline from the second 3 months. The total exports of aluminum sulphate for the 9 months of 1923 amounted to 26,626,356 lb., valued at $385,769.

The amounts of sodas and sodium compounds despatched to foreign countries in the past quarter surpassed those of the corresponding quarter of 1922 both in quantity and value, but those for the 9 months of 1923, though exceeding in quantity those for the 9 months of 1922, diminished in value, figures for which were 316,607,032 lb., $7,846,248.

Pigments, Paints and Varnishes Still Increasing

The exports of pigments, paints and varnishes during the third quarter of 1923 continued the rapid growth begun about a year ago and were higher than either of the preceding quarters; the first quarter was valued at $3,690,980, and showed a gain of 41 per cent over the first quarter of 1922; the second quarter, at $4,501,654, a gain of 53 per cent; and the third quarter, at $4,792,856, a gain of 77 per cent. The total exports for the 9 months had a value of $12,738,377, a gain of 52 per cent.

As compared with the third quarter of 1922, only a slight change was made in foreign sales of zinc oxide during the third quarter of 1923, but when compared with the 9 months of 1922 a 36 per cent gain in value and a 45 per cent gain in quantity were made, the total shipments in the January-September, 1923, period equaling $584,394 (8,169,928 lb.). Foreign shipments of lithopone during the past quarter fell below those for 1922, but for the three quarters were above in value and slightly below in quantity.

Fertilizers and Fertilizer Materials

The exports of fertilizers and fertilizer materials expanded 32 per cent in value and 27 per cent in quantity during the first 9 months of 1923 as compared with the corresponding period of 1922, having risen from $13,082,630 (707,738 tons) to $17,210,449 (896,332 tons). As was characteristic of the other groups, this class also showed a loss in the third quarter from the second quarter, but a gain over the first quarter.

Demand for sulphate of ammonia, which formed more than half of this group, advanced 28 per cent from $7,076,650 (120,959 tons) in the first 9 months of 1922, to $9,087,848 (124,600 tons) in the first 9 months of 1923. Of the foreign countries receiving United States sulphate of ammonia, Japan took two-thirds of the total, and Cuba and Hongkong each one-tenth. During the 9 months of 1923 there was despatched $550,057 (12,309 tons) of other nitrogenous materials.

Naval Stores, Gums and Resins, Crude Drugs, Essential Oils

Foreign demand for American naval stores continued broadening until an aggregate value of $19,688,866 for the first 9 months of 1923 was attained, an increase of 46 per cent over the corresponding period of 1922. The sales, amounting to $7,259,454 in the third quarter, surpassed those for the first and second quarters. Rosin improved 59 per cent from $5,430,871 (601,780 bbl.) in January-September, 1922, to $8,636,552 (925,796 bbl.) in January-September, 1923, but during the past quarter the sales were less than those for the preceding quarters. The United Kingdom, with 231,699 bbl., worth $2,148,143 was still our best customer although not taking such a large percentage as formerly.

A rise in both quantity and value characterized the outward movement in spirits of turpentine both for the 9 months, when figures were 8,781,786 gal., valued at $9,688,256, and for the third quarter, 4,268,685 gal., $4,090,841.

Guano to Replace Soda Nitrate in Peru

Nitrogen for the farm lands of the Republic of Peru is to be secured in the future exclusively from Peruvian guano. Imports of nitrate of soda will be considered smuggling unless special permission is given to cover any essential use of that material.

The Compania Administradora del Guano is given a monopoly with the understanding that the material is to be sold to the consumers at cost plus freight and handling charges with an additional 5 per cent for commission.

This step has been taken in an effort to require the use of local material, which serves the purpose admirably.

Nash Heads Cement Makers of Great Britain

That the control of the cement industry in Great Britain has been obtained by a group headed by Sir Philip Nash is now definitely known. This control has been achieved through the gradual accumulation of a majority of the ordinary capital of the Associated Portland Cement Manufacturers, the company that controls the British Portland Cement Co.

Market Conditions

Consuming Industries Increase Buying Orders for Chemicals

Improvement Reported in Spot Trading and in Contract Withdrawals—Prices on Fairly Steady Basis

DEMAND for chemicals was along broader lines during the past week. Buying for current needs gave a stimulus to the spot market and shipping directions on old orders were more frequent. The improved call for stocks is said to reflect enlarged operations on the part of different industries. Interest also was reported from consumers who wished to place orders ahead. The fact that different important chemicals are offered on contracts at prices which are regarded as low has been an aid in attracting business in those selections.

Price changes for domestic chemicals during the week were unimportant but several imported chemicals were offered at reduced levels. In some cases this represented selling pressure to reduce spot holdings and in other cases was the result of lower markets abroad.

Of interest to the trade were hearings before the Tariff Commission in connection with petitions for changes in existing customs duties on oxalic acid, peroxide of barium and barbital. These hearings were conducted last week but no recommendations have yet been made by the commission.

The weighted index number for the week was higher but was again influenced more by fluctuations in important vegetable oils than by strength in chemicals. Cottonseed oil, which is the ranking vegetable oil, moved to higher price levels and this advance accounts for the rise in the index number.

Prussiates formed the center of attraction throughout the week because of the sharp declines in asking prices. For some time it has been difficult to arouse consuming interests either for prussiate of soda or prussiate of potash. This led to gradual price declines and finally to sharp downward revisions. Competition between foreign and domestic prussiates has been keen and this has aided in the movement of prices.

Bleaching powder remains of interest but has not improved its position and prices still are unstable with buyers looking for concessions and generally getting them. Demand is not heavy especially in view of the sharp break in values and it is evident that consumption has not been increased because of the price war among producers.

Acetic Acid—New business is along moderate lines, but producers are carrying contract orders against which deliveries are being made regularly and total movement to consuming trades is reported as seasonal. There is no change in the position of important raw materials and this is reflected in the maintenance of quotations for the acid. Quotations are \$3.38@\$3.63 per 100 lb. for 28 per cent; \$6.78@\$7.13 per 100 lb. for 56 per cent; \$9.58@\$9.83 per 100 lb. for 80 per cent; \$12@\$12.78 per 100 lb. for glacial.

Prussiate of Soda in Sharp Decline—Prussiate of Potash Also Lower—Bleaching Powder Easy — Tartaric Acid Weak—Fusel Oil Firm—Arsenic Holds Strong Position—Caustic Soda Active—Permanganate of Potash Easier — Barium Carbonate Lower for Shipment

Citric Acid—Holders of imported acid are eager to reduce stocks and buyers are not operating except when concessions are given. There is no stable price, as holders have been willing to consider bids and private terms have ruled in sales. The market price is given at 47@48c. per lb. according to seller. The quotation for domestic grades holds at 49@50c. per lb. but the tone is easy.

Lactic Acid—A decided improvement is reported in call for supplies. Different trades are buying and the market has assumed a steady position as a result of the freer movement of stocks. Prices are quoted at 4½@5c. per lb. for 22 per cent dark; 5½@6c. per lb. for 22 per cent light; 9½@10c. per lb. for 44 per cent dark; 11½@12c. per lb. for 44 per cent light.

Oxalic Acid—Investigation of oxalic acid by the Tariff Commission was completed by a hearing on Nov. 5 at which production costs here and in foreign countries were considered. There has been little difference recently between market quotations for foreign and domestic with the former held at 11¾@12c. per lb. on spot and the latter offered at 11¾c. per lb. at works. Demand is moderate with small lot transactions in the majority.

Sulphuric Acid—The market is working into a firm position as demand is increasing and stocks are being lowered by larger deliveries. Buying is reported to have gained for spot and prompt and likewise for contracts involving distant deliveries. Price concessions which were common in recent months are no longer prominent. Quotations are \$9@\$11 per ton for 60 deg. in tanks at works and \$15@\$16 per ton for 66 deg.

Tartaric Acid — Consuming demand has remained light and with selling pressure a factor values are easy with little stability to the quotations as openly given. Domestic grades are offered at the level of 32½c. per lb. which was established in the previous week. This price, however, suffers in comparison with values for imported acid, as the latter is quoted at 27@28c. per lb. Lower markets abroad have helped to weaken values in domestic markets.

Sodas

Acetate of Soda—Second hands appear to be well supplied and spot material is offered at 5c. per lb. and upward according to seller and quantity. First hands report a little better demand but have not made any change in quotations at works, which are 5½@5¾c. per lb. depending on quantity.

Bichromate of Soda—A fairly seasonal movement to consuming trades is reported but sellers are competing for new business and prices fail to strengthen. The lowest figure quoted is 7¼c. per lb. and prices range up to 7¾c. per lb. The inside figure is given for prompt shipment and is a works price. Contract prices are given at 7⅞@7¾c. per lb. but it is admitted that some contracts have been accepted under the inside figure and it is questionable just how low producers will go in order to book business.

Caustic Soda—Good call for export combined with active buying for domestic use gives an appearance of activity to the market. Recent reductions in price have encouraged buying for home account and export trade is good from some countries. In this connection it is noted that exports from the United Kingdom for the 9 months ended Sept. were 1,136,906 cwt. as compared with 1,184,651 cwt. for the corresponding period of 1922. The quotation for home and export is \$3.10 per 100 lb. in standard drums, for solid 76 per cent. Ground, flake and powdered are unchanged at \$3.50 per 100 lb.

Nitrate of Soda—According to reports from primary points nitrate sales have been comparatively inactive during the past fortnight and a total of only 706,226 metric quintals is reported for the period from September 25 to October 19, inclusive. The industry suffered for a time from the effects of a strike in the nitrate ports, caused largely by the abolition of a labor organization known as the Redondilla. For a time the strike assumed a very threatening appearance, but the danger now seems to have passed and working conditions in the north are gradually resuming their normal course. The officials of the nitrate companies still hope to exceed the estimates made for the year's production and sales of 2,500,000 tons.

The production figures for September were as follows:

	Tons 1923	Tons 1922	Tons 1913
Production, Sept.	153,000	97,000	205,000
Stocks in Chile, Sept. 30	927,000	1,495,000	752,000

The shipment figures for the first fortnight of October were cabled last week as follows:

Shipments to—	Tons 1923	Tons 1922	Tons 1913
Europe and Egypt	54,000	36,000	122,000
U. S. etc.	19,000	45,000	24,000
Japan and other countries	2,000	6,000	.....

There has been but little buying reported in domestic markets and spot material holds at $2.45 per 100 lb. with contract prices at the levels announced last summer.

Prussiate of Soda—The market has been featured by weakness in price. Sellers have competed strongly for business and values have suffered in the attempt to arouse buying interest. Imported goods on spot were marked down to 12½c. per lb. and even this figure was not firm, as there were rumors that goods had changed hands at 12c. per lb. Slow demand and pressure of foreign made goods were responsible for the break in values, as domestic grades were held at 13½c. per lb.

Potashes

Bichromate of Potash—Moderate improvement is reported in the trades which are consumers of this chemical and this has resulted in a wider movement of bichromate. The season is still backward, however, and present trading is relatively light. Prices do not vary much from the range recently in effect and 9½c. to 10c. per lb. represents the market with the range depending on seller and quantity.

Carbonate of Potash—Interest remains quiet and buying is largely confined to small lots. Prices do not fluctuate much, as the slow trading movement has brought about low levels and buying has not gained enough in volume to cause any reaction in values. Spot offerings of 80-85 per cent were held at 5¼@6c. per lb. and 96-98 per cent at 6½@6¾c. per lb. Hydrated is steady at 6½@6¾c. per lb.

Caustic Potash—Offerings of imported for shipment from abroad were available at 6¾@7c. per lb. and this kept the spot market in an easy position with stocks offered at 7c. per lb. Better inquiry was reported but business does not run to round lots.

Prussiate of Potash—This was one of the weakest items in the market. Prices have been going downward steadily in recent weeks. Consuming demand has been slow and repeated cuts in price have failed to bring out any sustained buying. Red prussiate is largely nominal on spot at 56@58c. per lb. with shipments offered at 54@55c. per lb. Yellow prussiate was quoted at 22½c. per lb. for shipment and this took away all interest in spot goods and prices for the latter were unstable and varied according to seller with rumors that 24c. per lb. could be done.

Miscellaneous Chemicals

Arsenic—A slight depression was reported in the earlier part of the week and some spot arsenic sold at 13½c. per lb. Later on interest increased and the tone of the market was stronger with 14c. per lb. as the lowest price heard for spot and prompt. There is nothing new in shipment prices from foreign countries and 14¼@14¾c. per lb. is given as representing sellers' views. Domestic arsenic on shipment is quoted at 13@13½c. per lb., but the quotation applies only on large tonnage to actual consumers.

Bleaching Powder—Interest in bleaching powder is largely a matter of price. The instability of values keeps buyers on edge and there is no concerted move to take on large stocks as long as asking prices are subjected to such competition. While $1.50 per 100 lb. was set as the market quotation for November and December deliveries, this quotation is honored more in the breach than in the observance. Sales have gone through at $1.25 per 100 lb. and even this figure is said to have been shaded. Prices therefore are largely a matter of negotiation and none of the factors in this market appears backward in meeting competition. Contract prices for deliveries over all of 1924 are on a basis of $1.35 per 100 lb. but there is no rush to place contracts and many consumers are looking for still lower levels.

Barium Carbonate—An easier feeling was reported in the local market with imported material offered at $68 per ton on shipments. Domestic material is holding at $70@$73 per ton at works.

Fusel Oil—Importations have been larger, but with no change in the butyl alcohol situation, prices continue firm around the $4.25 per gal. basis on crude, in drums. Traders, however, appear to have little confidence in the market.

Soda Ash—Buying has been well sustained and a satisfactory volume of business is being put through each week. Large deliveries are going forward on contracts and this keeps stocks from accumulating. Production is on a normal basis and domestic consumption is well up to normal standards. Contract prices are $1.25 per 100 lb., in bulk, for light ash 58 per cent, at works; $1.38 per 100 lb., in bags; and $1.63 per 100 lb., in bbl. Dense ash is offered at $1.35 per 100 lb., in bulk, $1.45 per 100 lb., in bags, and $1.69 per 100 lb., in bbl. These prices are for carlots with the usual premiums for less carlots.

Tin Products—No change has been made in asking prices for tin oxide and 47c. per lb. is still the inside price of sellers. Higher prices for tin crystals went into effect on the first of the month with the revised price at 32c. per lb. Bichloride of tin also was advanced and placed at 12½c. per lb.

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	167.18
Last week	166.93
Nov., 1922	158.00
Nov., 1921	147.00
Nov., 1920	240.00
Nov., 1919	239.00
Nov., 1918	279.00

Weakness in bleaching powder, glycerine and linseed oil did not offset the rise in crude cottonseed oil and the index number shows a gain of 25 points for the week.

Alcohol

Demand for denatured alcohol was good and steady prices prevailed in all quarters. No. 1 special, 190 proof, held at 41½c. per gal., in drums, carload lots, prompt shipment. Completely denatured, formula No. 1, 188 proof, was quotably unchanged at 42½c. per gal., in drums, carload basis. Ethyl spirits closed the week at $4.74@$4.79 per gal., in bbl., as to quantity. The call for methanol was moderate only and with offerings liberal prices were barely steady. First hands continued to quote on the 95 per cent material at 88c. per gal., in drums, carload lots.

Liquid Oxygen Used Successfully in Blasting

Liquid oxygen explosive has been successfully used in Colorado by the Department of the Interior in experimental mine blasting and road construction work at a cost of approximately one-half that of the gelatin dynamite required to do the same work. The experiments were conducted by E. D. Gardner, mining engineer of the Bureau of Mines, in co-operation with a representative of the Compressed Air Corporation.

A liquid oxygen explosive consists of gas black, wood pulp or some other carbonaceous material made up into cartridges and soaked in liquid oxygen. This explosive can be detonated similarly to ordinary dynamite with cap and fuse or with electric detonators.

The liquid oxygen was obtained from a plant designed to furnish oxygen gas and was shipped to the point of use in dewar flasks, which are made on the same principle as thermos bottles.

Coal-Tar Products

Crudes Offered Freely—Phenol Available at 25c.—Beta-Naphthol Steadies—Cresylic Acid Irregular

OFFERINGS of crudes were liberal, and prices, while quotably unchanged, presented an unsettled appearance. Some outside lots of benzene were traded in at concessions. Several producers were disposed to talk the market up in an effort to interest buyers in contracts, but so far as could be learned, business was confined chiefly to nearby material. Cresylic acid prices covered a wide range, depending on the quantity and grade. The spot market for phenol, U.S.P., was barely steady, with offerings reported at 25c. per lb., in drums. New production is coming along and competition is keen. Contract demand for naphthalene flake and ball has been fair only, notwithstanding the recent reduction in prices. One factor reported a higher market for beta-naphthol. Aniline oil was steady. Salicylates were in better request. Pyridine on spot was wholly nominal, due to the scarcity.

Aniline Oil—Producers reported the market as unchanged at 16c. per lb., in drums, prompt shipment from works.

Alpha-Naphthylamine—There were offerings at 35@36c. per lb., in bbl., immediate delivery. It was intimated that the inside figure could be shaded on forward business.

Benzene—Demand was moderate and prices in some quarters were easy. But producers announced no further changes, leading interests quoting 90 per cent benzene at 21c. per gal., tank cars, f.o.b. works. On the pure the nominal quotation stood at 23c. per gal., tank cars, f.o.b. works. The situation in the motor grades underwent no change for the better. Producers concede that the motor fuel situation controls the market for benzene.

Beta-Naphthol—One producer announced an advance of 3c. per lb. in beta-naphthol, technical, establishing the price at 25c. per lb., carload lots, and 26c. per lb. in less than carload lots. It is expected that other sellers will soon follow, as production has been rather light for some time past and selling pressure is no longer so apparent.

Cresylic Acid—Both domestic and imported acid could have been obtained at less than 70c. on contract. Prices heard still cover a wide range and for special grades some handlers continue to quote as high as 85c. per gal. Several shipments of cresylic acid, as well as coal-tar distillate, arrived here from abroad last week.

Dimethylaniline—Producers reported moderate buying interest, with quotations holding at 40@41c. per lb., in drums, as to quantity.

Naphthalene—Crude material of fair quality was offered for prompt shipment from abroad at 2¼@2½c. per lb., c.i.f. New York, with low grades available at 2c. per lb. and even less. Demand for crude was quiet. In the market for flake the interest centered in futures and it was possible to pick up supplies for 1924 delivery at 6c. per lb., in bbl. Ball, in cartons, was offered for shipment at 7c. per lb.

Ortho-Toluidine—Prices steadied in some quarters and nominal quotations range from 17@18c. per lb., in bbl., as to quantity and seller.

Phenol—It was reported that one producer of synthetic phenol offered supplies at 25c. per lb., in drums, immediate delivery. The market was inactive and while prices were generally maintained around 26c. per lb., the undertone was quite easy. On contract it was reported that 22½c. might be done.

Pyridine—Little could be picked up on spot and nominal quotations ranged from $5.75@$6 per gal. On futures prices ranged from $4.75@$5 per gal., with demand limited.

Solvent Naphtha—Demand was fair and first hands held out for 23c. per gal., tank cars, works, on the water-white.

Toluene—Stocks were not burdensome and prices held on the tank car basis of 24c. per gal., f.o.b. works.

British trade returns indicate that foreign trade in coal-tar products has increased. During the 9 months ended Sept. 30 the United Kingdom exported 1,141,541 gal. of benzene and toluene, which compares with 51,394 gal. for the corresponding period a year ago. The shipments of creosote and tar oils from the United Kingdom for the 9 months period amounted to 35,441,282 gal., comparing with 20,743,659 gal. a year ago. The gain in British exports of naphthalene was marked, the shipments for the 9 months reaching the total of 149,620 cwt., against 20,032 cwt. for the corresponding period a year ago. The United States was a heavy buyer of crude naphthalene in the British market.

Coal-tar dyes exported from the United Kingdom in the 9 months ended with September were 84,114 cwt., valued at £691,914, which compares with 34,958 cwt., valued at £466,794, in 1922.

Explosive Makers to Compile History of the Industry

The Institute of Makers of Explosives, which includes in its membership practically all the manufacturers of explosives in the country, is preparing a history of the explosives industry in the United States. This history is not to be a technical treatise, although it will naturally include a short account of important advances in the art, but will concern itself more particularly with the history of the different explosives plants, the companies that built them and the men who were responsible for their success.

The committee, of which T. W. Bacchus, vice-president of the Hercules Powder Co., is chairman, is anxious to secure data of the early days of the industry and its pioneers. It appeals to the readers of this journal to get in touch with A. P. Van Gelder (high explosives and black powder) or Hugo Schlatter (smokeless powder and military explosives) at 310 Delaware Trust Building, Wilmington, Del., if they have anything that might be of interest or help in this connection, such as personal stories of the pioneers, pictures of early plants, early catalogs or advertisements.

Trade Notes

Effective Aug. 31, the Polish excise tax on acetic acid has been increased from 6,000 marks to 12,000 marks per kilo. Payment of the tax may be delayed, but interest at the rate of 12 per cent annually will be charged on overdue taxes.

E. V. Peters will be the principal speaker at the meeting of the Paint, Oil and Varnish Club of New York, which will be held next Thursday evening at the Hotel Astor. At the recent Chicago conventions New York men were elected as presidents of the three major paint and varnish associations, and the newly elected officials will be guests of honor at the meeting. They include N. B. Gregg, president of the National Paint, Oil and Varnish Association; L. P. Moore, president Paint Manufacturers Association of the United States, and C. J. Roh, president of the National Varnish Manufacturers Association.

A receiver has been appointed for Becker & Co., paper pulp merchants of London, England, this being followed by a receivership for Charles Marsden & Sons. The difficulties of these firms are said to be connected with Canadian pulp interests.

A Russian corporation "Eksportchleb," according to the Danish Foreign Office Bulletin for Sept. 13, 1923, has been organized for the purpose of exporting oilseeds, oil cakes, vegetable oils and other foodstuffs.

The sale of the controlling portion of the shares of the Botany Worsted Mills, of Passaic, N. J., now held by the Alien Property Custodian, to a syndicate participated in by Blair & Co. and Max W. Stoehr has been authorized by an executive order signed by President Coolidge.

W. J. Thorn, of Innis, Speiden & Co., New York, was the recipent of a prize at the meeting of the Chemical Club of Philadelphia, Pa., Nov. 5, given by P. S. Tilden for the best paper answering questions prepared by Dr. F. S. Havens, following the completion of the course on "Practical Chemistry for Chemical Salesmen," given by the organization.

Vegetable Oils and Fats

Crude Cottonseed at New High—Linseed Lower—Active Call for Coconut Oil—Tallow Firm

ACTIVE trading was reported in crude cottonseed and coconut oil, at higher prices. Compound makers were buyers of the former, while much of the trading in the latter was attributed to Western speculative interests. Higher prices obtained on crude corn oil, menhaden oil and olive foots. Tallow and grease held firm. Palm oils were irregular.

Cottonseed Oil — Following closely upon the publication of the revised estimate on production of cotton the market took on a firm undertone and prices advanced to new highs for the movement. A leading maker of lard compound bought fully 200 tank cars of nearby crude oil on the basis of 10c. per lb., f.o.b. mills. Subsequent business was booked at 10¼c. per lb. The offerings were light and towards the close mills generally quoted 10½c. per lb. With a crop of 10,248,000 bales in sight production of oil, according to traders, should be ample for the needs of the industry, but actual holders of seed marked up prices in sympathy with the sharp uplift in cotton, and the question of supply and demand may not come up for consideration for some little time to come. Spot holdings of refined prime summer yellow oil are in strong hands and for goods out of store 13½c. was asked, cooperage included. March oil in the option market sold over 12c. per lb., but some good selling developed on the bulge, speculators as well as refiners' brokers offering freely. Bleachable oil advanced to 10¾@10⅞c. per lb., tanks, f.o.b. Texas common points. Lard compound closed ¼c. higher at 13¾@14c. per lb., in bbl., carload basis. Demand for compound was good, but confined almost entirely to current needs.

Linseed Oil—Spot oil was lowered to 90c. per gal., in bbl., carload lots, a decline of 2c. for the week. November oil was offered at 89c. per gal., with December at 87@88c. per gal. January-April closed at 86@87c., with January-June at 85@86c. per gal., cooperage basis, carload lots, the price varying according to the seller. Demand was quiet throughout the week, which offset steadiness in seed. Consumers look for a lower market after the turn of the year, believing that a bumper Argentine crop will turn the tide in their favor. Crop news from the Argentine continues favorable. The November crop report, issued by the Department of Agriculture on Thursday, forecast the United States yield at 19,343,000 bu., a slight reduction from the October figures. Receipts of seed at the two principal Northwestern terminals since September 1 have amounted to 8,650,000 bu., comparing with 3,950,000 bu. for the corresponding period a year ago. The receipts of domestic seed from 1922 production amounted to approximately 10,000,000 bu. Exports of flaxseed from the Argentine since the first of January have reached the total of 42,200,000 bu., and, according to private reports, the stocks of old crop seed now on hand are small. November seed at Buenos Aires has been steady on covering by shorts.

China Wood Oil—A fair inquiry was reported for China wood oil and steady prices prevailed. Sales of futures were reported at 20½c. per lb., in bbl., regular import terms. Dealers were buyers in the Orient, steadying the market there.

Coconut Oil—The feature was the reported buying of January-March Ceylon type oil by speculative interests on the basis of 8¼c. per lb., sellers' tanks, coast.

The latest official report on condition of the cotton crop places the yield at 10,248,000 bales, which compares with 11,015,000 bales a month ago. The report everywhere was regarded as extremely bullish and prices for cottonseed oil advanced sharply. The October 25 report on this year's crop, together with the final report for the past 5 years, follows:

	Bales.
1923	10,248,000
1922	9,762,000
1921	7,953,641
1920	13,439,603
1919	11,420,763
1918	12,941,000

Late in the week bids at 8¼c. coast for January forward oil were turned down. November-December sold at 8¼c. coast. Operators point to the comparative low market for this material, contrasted especially with cottonseed oil. Copra closed at 5c. bid, c.i.f. Pacific coast ports.

Corn Oil—Early in the week 10c. was paid for crude. Later bids at 10¼c. were turned down, sellers' tanks, f.o.b. mills. Crude on spot settled at 11⅛@11⅜c. per lb., in bbl.

Olive Oil Foots—Prime green Italian foots advanced to 8¼c. per lb., spot. Other brands could have been picked up at 8⅛@8¼c. per lb.

Palm Oils—Spot offerings were liberal and the market was irregular, Lagos closing at 7⅛@7⅜c. per lb. Niger on spot 7.10c.; futures at 7.05c. per lb.

Rapeseed Oil—Refined oil on spot at 71@73c. per gal., in bbl., but later the market steadied. On futures asking prices ranged from 72½@73c. per gal., regular import terms.

Sesame Oil—January shipment from abroad closed at 11.80c. per lb., in bbl. There was a good call for nearby material. Cables from Rotterdam reported buying by America.

Soya Bean Oil—Bulk oil for shipment from the Orient was offered at 7½c. per lb., in bond, c.i.f. New York. Prompt shipment from the Pacific coast closed at 9¼c. per lb., sellers' tanks, duty paid. No trading.

Fish Oils—Newfoundland cod oil was firm at 87@88c. per gal. Crude menhaden oil was advanced to 50c. asked, tank cars, f.o.b. factory, with no sales. Fishing in South fair.

Tallow and Greases—Extra special tallow held at 8c. per lb., ex plant., with the undertone firm. White grease, 7¾@8c., and yellow at 6⅞@6⅝c. per lb., as to acidity. Market quiet.

Oleo Stearine—Sales of several cars at 11¼c. per lb., a decline of ¼c. No. 1 oleo oil firm at 14½@15c. per lb.

Miscellaneous Materials

Antimony — Chinese and Japanese brands 9¼c. Cookson's "C" grade, 12@12½c. Chinese needle antimony, lump, nominal, 6.50c. per lb. Standard powdered needle antimony (200 mesh), 7@8c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, 7.50@8c.

Barytes—Demand good and prices generally steady. Unbleached and bleached, ground, $28@$30 per ton, f.o.b. St. Louis. Off color $12@$14 per ton, f.o.b. Baltimore.

Casein—Offerings from the Argentine increased and prices easier. Technical grades now quoted at 13@14c. per lb., immediate delivery. On futures the inside figure could have been shaded.

Glycerine—The market was ¼c. lower on dynamite glycerine, sales passing in the West at 16c. per lb., carload lots, drums included. Chemically pure was irregular and prices named ranged from 16½@16⅝c. per lb., carload lots, drums included, prompt shipment. Soap-lye, basis 80 per cent, loose, held at 19⅜c. per lb., f.o.b. shipping point. Saponification, basis 88 per cent, loose, nominal at 12@12½c. per lb.

Shellac—Business slow and with no change in Calcutta closing prices were barely steady on the basis of 61c. per lb. for T.N. Bonedry, bleached, held nominally at 72@73c. per lb.

Turpentine—Spirits closed at 97c. per gal., a decline of 1c. for the week. Trading routine only.

White Lead—The metal market has held on a steady basis and the same is true of the pigments. Demand for white lead is good especially in the eastern part of the country. Contract deliveries are of good volume and there is a steady jobbing demand. Dry white lead is quoted at 9¼c. per lb. in casks.

Zinc Oxide—Most consumers are covered on contracts and trading in the open market is not important. Prices for delivery over the remainder of the year are fixed at 8c. per lb. for American process, lead free. French process, red seal, is steady at 9⅜c. per lb.

Imports at the Port of New York

November 2 to November 8

ACIDS—Cresylic—10 dr., Liverpool, Industrial Chemical Co.; 55 dr., Glasgow, B. & O. Railroad; 58 dr., Glasgow, Order. **Lactic**—26 csk., Hamburg, C. B. Richard & Co. **Stearic**—20 cs., Rotterdam, Parsons & Plymouth Organic Lab. **Tartaric**—200 bbl., Bari, Order; 200 keg, Hamburg, Order; 500 csk., Trieste, Superfos Co.

ALCOHOL—1 bbl. butyl, Havre, De Mattia Chemicals, Inc.

ANILINE OIL—4 dr., Lisbon, Order.

ANTIMONY OXIDE—8 csk., London, L. H. Butcher & Co.; 109 csk., Newcastle on Tyne, E. Hill's Son & Co.

ANTIMONY REGULUS — 1,000 cs., Shanghai, Int'l. Banking Corp.; 550 cs., Shanghai, Wah Chang Trading Corp.

AMMONIUM CARBONATE — 20 csk., Liverpool, Farmers Loan & Trust Co.

ARSENIC—187 csk., Hamburg, Central Union Trust Co.; 63 csk., Hamburg, Central Union Trust Co., 500 cs., Changoha, Gitlan & Co.

BARIUM SUPEROXIDE—78 cs. and 59 csk., Hamburg, W. A. Brown & Co.

BARYTES—200 bg., Bremen, New York Trust Co.; 1,000 bg., Genoa, Bankers Trust Co.; 3 bg., Genoa, Iron & Ore Corp. of Am.; 200 bg., Bremen, New York Trust Co.

BAUXITE—106 tons (bulk), Paramaribo, A. M. Kohler.

BLACK PIGMENT—100 csk., Rotterdam, C. J. Osborn Co.

BRONZE POWDER — 54 cs., Bremen, Baer Bros.; 10 cs., Hamburg, Kuper Bros.

CALCIUM CITRATE—162 cs., Messina, C. Pfizer & Co.

CALCIUM CYANIDE—136 cs., Hamburg, Roessler & Hasslacher Chemical Co.; 18,908 dr., Hamburg, American Cyanamid Co.

CHALK — 300 bg., Antwerp, Bankers Trust Co.; 300 bg. and 200 csk., Bristol, H. J. Baker & Bros.; 500 tons (bulk), London, Baring Bros. & Co.; 112 bg., London, Chemical National Bank.

CHEMICALS—500 bg., Glasgow, Brown Bros. & Co.; 560 bg., Glasgow, Coal & Iron National Bank; 552 csk., Rotterdam, Chemical National Bank; 220 csk., Rotterdam, Equitable Trust Co.; 362 csk., Rotterdam, Stanley-Daggett, Inc.; 262 pkg., Hamburg, Roessler & Hasslacher Chemical Co.; 49 csk., Hamburg, A. Klipstein & Co.; 2 csk. aniline, Hamburg, Franklin Import & Export Co.; 2 csk. do., Hamburg, Kuttroff, Pickhardt & Co.; 6 pkg., Hamburg, Eimer & Amend; 2 cs., Havre, Mallinckrodt Chemical Works; 93 cs., Bremen, Pfaltz & Bauer.

CHINA CLAY—325 bg., Bristol, Bankers Trust Co.; 100 tons, Bristol, Lunham & Moore.

COAL-TAR DISTILLATE — 115 dr., Liverpool, W. Foster; 190 dr., Liverpool, Monsanto Chemical Works.

COBALT—42 bg. ore, Sydney, International Nickel Co.; 42 bg. do., Sydney, J. C. Wiarda.

COLORS — 29 csk., Rotterdam, H. A. Metz & Co.; 23 csk. aniline, Rotterdam, Garfield Aniline Works; 14 csk. do., Rotterdam, Carbic Color & Chemical Co.; 36 csk. do., Rotterdam, Equitable Trust Co.; 56 pkg. do., Rotterdam, Grasselli Chemical Co.; 67 pkg. do., Rotterdam, Kuttroff, Pickhardt & Co.; 14 csk. do., Rotterdam, G. A. Kuhl; 15 keg aniline, Genoa, Irving Bank-Col. Trust Co.; 3 keg do., Genoa, National City Bank; 18 csk. do., Genoa, American Exchange National Bank; 11 keg, Genoa, Ladenburg, Thalmann & Co.; 11 keg, Genoa, Order; 23 pkt., Havre, Ciba Co.; 3 bbl. aniline, Antwerp, Fidelity Int'l. Trust Co.

CREAM TARTAR—25 keg, Genoa, Magnus, Mabee & Reynard; 100 keg, Genoa, C. L. Huisking, Inc.

DEXTRINE—50 bg., Rotterdam, Spier, Simons & Co.

FUSEL OIL—1 csk., Hamburg, Maas & Waldstein; 2 dr., Dunkirk, Order.

FULLERS EARTH—350 bg., Bristol, L. A. Salomon & Bros.; 350 bg., London, L. A. Salomon & Bros.; 250 bg., London, Order.

GAMBIER — 275 cs. block and 160 bg. cube, Singapore, Order; 350 cs., Singapore, American Exchange National Bank; 309 bg. cube, Singapore, Order.

GLYCERINE—50 dr., London, Marx & Rowolle.

GUMS—300 cs. damar, Batavia, Order; 200 bbl. manjak, Barbados, Chase National Bank; 23 pkg. tragacanth, Constantinople, Order; 102 bg. copal, Antwerp, National City Bank; 600 bg. copal, Antwerp, Central Union Trust Co.; 449 bg. copal, Antwerp, Order; 13 bg. copal, Liverpool, World's Products Trading Co.; 210 bg. damar, Singapore, Order; 100 bbl. copal, Manila, Chartered Bank of India, Austr. & China; 867 bg. yacca, Adelaide, Order; 14 cs. kauri, London, Davies, Turner & Co.; 17 bg. copal, London, S. Winterbourne & Co.

IODINE—100 bbl. crude, Iquque, Nash, Watjen & Bangs.

IRON OXIDE—40 bbl., Malaga, Hummel & Robinson; 156 bbl., Malaga, Reichard-Coulston, Inc.; 60 bbl., Malaga, J. Lee Smith & Co.; 19 bbl., Malaga, L. H. Butcher & Co.; 35 csk., Bristol, Reichard-Coulston, Inc.; 5 csk., Liverpool, E. M. & F. Waldo; 10 csk., Liverpool, Stanley, Daggett, Inc.; 10 csk., Manchester, Order.

IRON SULPHIDE—25 csk., Hamburg, Order; 4 cs., Bremen, Mallinckrodt Chemical Works.

LITHOPONE—60 csk., Bremen, Order.

MAGNESITE — 250 bg., Rotterdam, Brown Bros. & Co.

MAGNESIUM CARBONATE — 20 cs., Liverpool, E. & J. Burke, Ltd.

MAGNESIUM CHLORIDE — 110 dr., Hamburg, Order.

MYROBALANS — 6,475 pkt., Colombo, Mechanics & Metals National Bank.

NAPHTHALENE — 860 bg., Hamburg, Order; 227 bg. Bristol, Order; 265 bg. Manchester, Order; 387 bg., London, Irving Bank-Col. Trust Co.

NICKEL SULPHATE—24 csk., Bristol, Order.

OCHER—63 pkg., Marseilles, Reichard-Coulston, Inc.

OILS—Cod—100 csk., St. Johns, Cook & Swan Co.; 10 csk., St. Johns, E. H. Laing; 100 csk., St. Johns, R. Badcock & Co.; 100 bbl., Aberdeen, Chemical National Bank; 200 bbl., Aberdeen, J. D. Irwin & Co.; 100 bbl., Aberdeen, Order; 150 cs., Hull, Order. **China Wood** — 572 csk., Hankow, Jardine, Matheson & Co.; 305 csk., Hankow, Union Bank of Canada; 151 csk., Hankow, G. W. S. Patterson & Co.; 62 bbl., London, S. Winterbourne & Co. **Coconut** — 655 tons, Manila, Order. **Linseed**—130 dr., Rotterdam, W. Van Doorn; 10 cs., London, Order. **Olive foots** (sulphur oil)—100 bbl., Naples, Ellis, Jackson & Co., 1,000 bbl., Bari, National City Bank; 500 bbl., Bari, Order. **Palm**—72 csk., Liverpool, Order; 530 csk., Hamburg, African & Eastern Trading Co.; 26 csk, Hamburg, Order. **Rapeseed**—270 bbl., Hull, Balfour, Williamson & Co.; 186 bbl., Hull, Order. **Sperm**—30 bbl., Glasgow, Order.

PITCH—217 bbl., Hull, Ellerman, Wilson Line.

PLUMBAGO—144 bbl., Colombo, McCullough, Dalzelle Crucible Co.; 200 bbl., Colombo, Patterson, Boardman & Knapp; 96 bbl., Colombo, Order; 150 bbl., Colombo, Order.

POTASSIUM SALTS—67 csk., Hamburg, Equitable Trust Co., 400 csk. caustic, Hamburg, A. Klipstein & Co.; 25 cs. bromide, Hamburg, Order; 171 csk. alum, Hamburg, Order; 2,000 bg. muriate, 2,000 bg. sulphate and 2,750 bg. manure salt, Hamburg, Potash Importing Corp. of Am.; 4 bbl. prussiate, Havre, Fezandie & Sperrie; 783 bg. muriate, Hamburg, New York Trust Co.; 18 csk. prussiate, Liverpool, Order.

PYRITES—6,739,040 kilos, Huelva, The Pyrites Co.

SAL AMMONIAC — 102 bbl., Hamburg, Roessler & Hasslacher Chemical Co.

SHELLAC—50 bg., Hamburg, Irving Bank-Col. Trust Co.; 200 bg., Calcutta, Chase National Bank; 200 bg., Calcutta, London & Brazilian Bank; 600 bg., Calcutta, Anglo South American Bank; 2,489 bg. and 106 bg. seedlac, Calcutta, Order; 100 bg., Colombo, General Electric Co.; 634 bg., Southampton, Order; 94 cs. Marseilles, Order.

SILVER SULPHIDE—81 cs. Antofagasta, Watson, Geach & Co.

SODIUM SALTS—17 csk. prussiate, Rotterdam, Chase National Bank; 18 csk. prussiate, Liverpool, Order; 8 bbl. prussiate, Havre, Fezandie & Sperrie; 6 csk. bifluoride, Hamburg, Innis, Speiden & Co.; 4,526 bg. nitrate, Mejillones, Wessel, Duval & Co.; 6,872 bg. do., Mejillones, W. R. Grace & Co.; 7,866 bg. do., Meiillones, A. Gibbs & Co.; 12 keg sulphite, Bristol, J. W. Hampton & Co.; 38 cs. chlorate, Genoa, Order; 14,976 sk. nitrate, Antofagasta, W. R. Grace & Co.

SUMAC—20 csk. extract, Glasgow, American Dyewood Co.; 350 bl. ground, Palermo, Core & Herbert; 1,610 bl., Palermo, Order.

TALC—100 bg., Genoa, L. A. Salmon & Bros.; 300 bg., Genoa, Bankers Trust Co.

TARTAR—502 bg., Oran, Tartar Chemical Works; 194 bg., Marseilles, C. Pfizer & Co.; 404 bg., Marseilles, Tartar Chemical Co.; 94 bg., Lisbon, C. Pfizer & Co.; 82 cs., Leghorn, Order; 11 csk., Leghorn, C. B. Richard & Co.; 342 bg., Lisbon, C. Pfizer & Co.

VANADIUM—12,000 bg., Callao, Vanadium Corp.

WAXES — 8 pkg. bees, Monte Christy, J. A. Thomen; 8 pkg. do., Monte Christy, Order; 375 bg. montan, Bremen, W. Schall & Co.; 1,120 bg. paraffine, London, F. L. Kraemer & Co.; 107 bg. montan, Hamburg, Order; 49 bg. bees, Lisbon, D. Troengrare; 46 pkg. bees, Lisbon, Order; 31 bg. bees, San Antonio, D. Steengrafe; 25 bg. bees, Valparaiso, D. Steengrafe.

WOOL GREASE—100 bbl. and 30 csk., Bremen, Pfaltz & Bauer; 10 cs., Bremen, Order; 6 bbl., Hull, F. J. Markwalter & Co.; 88 bbl., Hull, Elbert & Co.; 100 bbl., Antwerp, Mechanics & Metals National Bank; 52 cs., Antwerp, Order.

ZINC WHITE — 125 bbl., Marseilles, Reichard-Coulston, Inc.

Latest Quotations on Industrial Stocks

	Last Week	This Week
Air Reduction	63¼	64½
Allied Chem. & Dye	64	64½
Allied Chem. & Dye pfd.	106½	107
Am. Ag. Chem.	10¼	11
Am. Ag. Chem. pfd.	31¼	30¼
American Cotton Oil	5¾	5¾
American Cotton Oil pfd.	18¼	18
American Cyanamid	74	75½
Am. Drug Synd.	6	5¾
Am. Linseed Co.	15½	17
Am. Linseed pfd.	29½	34½
Am. Smelting & Refining Co.	54½	55½
Am. Smelting & Refining pfd.	96	96½
Archer-Daniels Mid. Co., w.i.	25	25
Archer-Daniels Mid. Co. pfd.	90½	91½
Atlas Powder	54	54
Casein Co. of Am.	*64	*64
Certain-Teed Products	30	30
Commercial Solvents "A"	*33	35
Corn Products	127	129⅝
Corn Products pfd.	116½	117
Davison Chem.	*47	52
Dow Chem. Co.	48⅝	48¾
Du Pont de Nemours	129½	132½
Du Pont de Nemours db.	84¾	85
Freeport-Texas Sulphuric	11¼	11¼
Glidden Co.	7	7
Grasselli Chem.	*132	*132
Grasselli Chem. pfd.	*145	*145
Hercules Powder	108	*108
Hercules Powder pfd.	104	*104
Heyden Chem.	1	1
Int'l Ag. Chem. Co.	*1½	⅝
Int'l Ag. Chem. pfd.	4½	5
Int'l Nickel	10⅜	10⅞
Int'l Nickel pfd.	76	78
Int'l Salt	83½	83½
Mathieson Alkali	35	35
Merck & Co.	*70	*70
National Lead	120½	122
National Lead pfd.	112½	111½
New Jersey Zinc	140	140
Parke, Davis & Co.	78	78
Pennsylvania Salt	88½	88½
Procter & Gamble	*134	*134
Sherwin-Williams	*32	*32
Sherwin-Williams pfd.	*100	*100
Tenn. Copper & Chem.	8⅝	8⅞
Texas Gulf Sulphur	58⅝	61
Union Carbide	53½	54½
United Drug	74½	76½
United Dyewood	*42½	*42½
U. S. Industrial Alcohol	53	55½
U. S. Industrial Alcohol pfd.	98	*100
Va.-Car. Chem. Co.	7⅛	7⅞
Va.-Car. Chem. pfd.	22	24⅞

*Nominal. Other quotations based on last sale.

Current Prices in the New York Market

For Chemicals, Oils and Allied Products

THESE prices are for the spot market in New York City, but a special effort has been made to report American manufacturers' quotations whenever available. In many cases these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported stocks are reported when they are of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

General Chemicals

Acetone, drums	lb.	$0.25 – $0.25½
Acetic anhydride, 85%, dr.	lb.	.38 – ....
Acid, acetic, 28%, bbl.	100 lb.	3.38 – 3.63
Acetic, 56%, bbl.	100 lb.	6.75 – 7.00
Acetic, 80%, bbl.	100 lb.	9.58 – 9.83
Glacial, 99½%, bbl.	100 lb.	12.00 – 12.78
Boric, bbl.	lb.	.10 – ....
Citric, kegs	lb.	.47 – .49½
Formic, 85%	lb.	.12 – .14
Gallic, tech.	lb.	.45 – .50
Hydrofluoric, 52%, carboys	lb.	.11 – .12
Lactic, 44%, tech., light, bbl.	lb.	.11½ – .12
22% tech., light, bbl.	lb.	.05½ – .06
Muriatic, 18° tanks	100 lb.	.90 – 1.00
Muriatic, 20°, tanks	100 lb.	1.00 – 1.10
Nitric, 36°, carboys	lb.	.04½ – .05
Nitric, 42°, carboys	lb.	.05½ – .05½
Oleum, 20%, tanks	ton	18.50 – 19.00
Oxalic, crystals, bbl.	lb.	.11½ – .12
Phosphoric, 50% carboys	lb.	.07½ – .08½
Pyrogallic, resublimed	lb.	1.50 – 1.60
Sulphuric, 60°, tanks	ton	9.00 – 11.00
Sulphuric, 60°, drums	ton	13.00 – 14.00
Sulphuric, 66°, tanks	ton	15.00 – 16.00
Sulphuric, 66° drums	ton	20.00 – 21.00
Tannic, U.S.P., bbl.	lb.	.65 – .70
Tannic, tech., bbl.	lb.	.45 – .50
Tartaric, imp., powd., bbl.	lb.	.27½ – .28½
Tartaric, domestic, bbl.	lb.	.32½ – ....
Tungstic, per lb.	lb.	1.10 – 1.20
Alcohol, butyl, drums, f.o.b. works	lb.	.26 – .28
Alcohol ethyl (Cologne spirit), bbl.	gal.	4.77 – ....
Ethyl, 190 p'f. U.S.P., bbl.	gal.	4.74 – ....
Alcohol, methyl (see Methanol)		
Alcohol, denatured, 190 proof		
No. 1, special bbl.	gal.	.47½ – ...
No. 1, 190 proof, special, dr.	gal.	.41½ – ...
No. 1, 188 proof, bbl.	gal.	.48½ – ...
No. 1, 188 proof, dr.	gal.	.42½ – ...
No. 5, 188 proof, bbl.	gal.	.46½ – ...
No. 5, 188 proof, dr.	gal.	.40½ – ...
Alum, ammonia, lump, bbl.	lb.	.03½ – .04
Potash, lump, bbl.	lb.	.03 – .03½
Chrome, lump, potash, bbl.	lb.	.05½ – .06½
Aluminum sulphate, com., bags	100 lb.	1.40 – 1.50
Iron free bags	lb.	2.40 – 2.50
Aqua ammonia, 26°, drums	lb.	.07 – .07½
Ammonia, anhydrous, cyl.	lb.	.30 – .30½
Ammonium carbonate, powd. tech., casks	lb.	.09 – .09½
Ammonium nitrate, tech., casks	lb.	.09 – .10
Amyl acetate tech., drums	gal.	4.50 – 4.75
Antimony Sulphuret, golden.	lb.	.19 – .20
Arsenic, white, powd., bbl.	lb.	.14 – .14½
Arsenic, red, powd., kegs	lb.	.15 – .15½
Barium carbonate, bbl.	ton	68.00 – 69.00
Barium chloride, bbl.	ton	83.00 – 90.00
Barium dioxide, 88%, drums	lb.	.17½ – .18
Barium nitrate, casks		.07½ – .08
Blanc fixe, dry, bbl.	lb.	.04 – .04½
Bleaching powder, f.o.b. wks., drums	100 lb.	1.25 – 1.50
Spot N. Y. drums	100 lb.	2.00 – 2.10
Borax, bbl.	lb.	.05½ – .05½
Bromine, cases	lb.	.28 – .30
Calcium acetate, bags	100 lb.	4.00 – 4.05
Calcium arsenate, dr.	lb.	.12 – .14
Calcium carbide, drums	lb.	.05 – .05½
Calcium chloride, fused, dr. wks.	ton	21.00 – ....
Gran. drums works	ton	27.00 – ....
Calcium phosphate, mono, bbl.	lb.	.06½ – .07
Camphor, cases	lb.	.85 – .86
Carbon bisulphide, drums	lb.	.06 – .06½
Carbon tetrachloride, drums	lb.	.09 – .09½
Chalk, precip.—domestic, light, bbl.	lb.	.04½ – .04½
Domestic, heavy, bbl.	lb.	.03½ – .04
Imported, light, bbl.	lb.	.04½ – .05
Chlorine, liquid, tanks, wks.	lb.	.04 – .04½
Cylinders, 100 lb., wks.	lb.	.05½ – .06
Cylinders, 100 lb., spot	lb.	.08½ – .09
Chloroform, tech., drums	lb.	.30 – .32
Cobalt, oxide, bbl.	lb.	2.10 – 2.25
Copperas, bulk, f.o.b. wks.	ton	21.00 – 24.00
Copper carbonate, bbl.	lb.	.18 – .19
Copper cyanide, drums	lb.	.47 – .50
Copper sulphate, dom., bbl., 100 lb.		4.80 – 4.90
Imp bbl.	100 lb.	4.40 – 4.50
Cream of tartar, bbl.	lb.	.22½ – .25½
Epsom salt, dom., tech., bbl.	100 lb.	1.75 – 2.00
Epsom salt, imp., tech., bags	100 lb.	1.00 – ....
Epsom salt, U.S.P., dom., bbl.	100 lb.	2.25 – 2.50
Ether, U.S.P., resale, dr.	lb.	.13 – .15
Ethyl acetate, 85%, drums	gal.	.92 – .95
Ethyl acetate, 100%, dr.	gal.	$1.05 – $1.10
Formaldehyde, 40%, bbl.	lb.	.11 – .11½
Fullers earth—f.o.b. mines	ton	18.00 – 20.00
Fusel oil, ref., drums	gal.	.... – ....
Fusel oil, crude, drums	gal.	4.25 – ....
Glaubers salt, wks., bags	100 lb.	1.20 – 1.40
Glaubers salt, imp., bags	100 lb.	.90 – .95
Glycerine, c.p., drums extra	lb.	.16½ – .17
Glycerine, dynamite, drums	lb.	.16 – .16½
Glycerine, crude 80%, loose	lb.	.10½ – .11
Iron oxide, red, casks	lb.	.12 – .18
Lead: White, basic carbonate, dry, casks	lb.	.09½ – .09½
White, basic sulphate, casks	lb.	.08½ – .09
White, in oil, kegs	lb.	.11½ – .11½
Red, dry, casks	lb.	.10½ – .10½
Red, in oil, kegs	lb.	.13 – .14½
Lead acetate, white crys., bbl.	lb.	.14 – .14½
Brown, broken, casks	lb.	.13 – .13½
Lead arsenate, powd., bbl.	lb.	.18 – .20
Lime-Hydrated, bg, wks.	ton	10.50 – 12.50
Bbl., wks.	ton	18.00 – 19.00
Lime, Lump, bbl.	280 lb.	3.63 – 3.65
Litharge, comm., casks	lb.	.10½ – .10½
Lithopone, bags	lb.	.07 – .07½
in bbl.	lb.	.07½ – .07½
Magnesium carb., tech., bags	lb.	.08 – .08½
Methanol, 95%, bbl.	gal.	.93 – ....
Methanol, 97%, bbl.	gal.	.95 – ....
Methyl-acetone, t'ks.	gal.	1.15 – ....
Nickel salt, double, bbl.	lb.	.10½ – ....
Nickel salts, single, bbl.	lb.	.11½ – ....
Phosgene	....	.60 – .75
Phosphorus, red, cases	lb.	.... – ....
Phosphorus, yellow, cases	lb.	.35 – .40
Potassium bichromate, casks	lb.	.09½ – .09¾
Potassium bromide, gran., bbl.	lb.	.19 – .20
Potassium carbonate, 80-85%, calcined, casks	lb.	.06½ – .06½
Potassium chlorate, powd.	lb.	.07½ – .08½
Potassium cyanide, drums	lb.	47 – .52
Potassium, first sorts, cask	lb.	08 – .08½
Potassium hydroxide (caustic potash) drums	lb.	.06½ – .07
Potassium iodide, cases	lb.	3.65 – 3.75
Potassium nitrate, bbl.	lb.	.07½ – .09
Potassium permanganate, drums	lb.	.17½ – .17½
Potassium prussiate, red, casks	lb.	.56 – .58
Potassium prussiate, yellow, casks	lb.	.22½ – .24½
Salammoniac, white, gran., casks, imported	lb.	.06½ – ....
Salammoniac, white, gran., bbl., domestic	lb.	.07½ – .07¾
Gray, gran., casks	lb.	.08 – .09
Salsoda, bbl.	100 lb.	1.20 – 1.40
Salt cake (bulk)	ton	22.00 – 23.00
Soda ash, light, 58% flat, bulk, contract	100 lb.	1.25 – ....
bags, contract	100 lb.	1.38 – ....
Soda ash, dense, bulk, contract, basis 58%	100 lb.	1.35 – ....
bags, contract	100 lb.	1.45 – ....
Soda, caustic, 76%, solid, drums contract	100 lb.	3.10 – ....
Soda, caustic, ground and flake, contracts, dr.	100 lb.	3.50 – 3.85
Soda, caustic, solid, 76% f. a. s. N. Y.	100 lb.	3.00 – 3.10
Sodium acetate, works, bbl.	lb.	.05¼ – .05½
Sodium bicarbonate, bulk	100 lb.	1.75 – ....
330-lb. bbl.	100 lb.	2.00 – ....
Sodium bichromate, casks	lb.	.07¼ – .07½
Sodium bisulphate (niter cake)	ton	6.00 – 7.00
Sodium bisulphite, powd., U.S.P., bbl.	lb.	.04½ – .04½
Sodium chlorate, kegs	lb.	.06½ – .07
Sodium chloride	long ton	12.00 – 13.00
Sodium cyanide, cases	lb.	.19 – .22½
Sodium fluoride, bbl.	lb.	$0.08½ – $0.10½
Sodium hyposulphite, bbl.	lb.	.02½ – .02½
Sodium nitrite, casks	lb.	.07½ – ....
Sodium peroxide, powd., cases	lb.	.28 – .30
Sodium phosphate, dibasic, bbl.	lb.	.03½ – .04
Sodium prussiate, yel. drums	lb.	.12 – .13½
Sodium salicylic, drums	lb.	.40 – .42
Sodium silicate (40°, drums)	100 lb.	.75 – 1.15
Sodium silicate (60°, drums)	100 lb.	1.75 – 2.00
Sodium sulphide, fused, 60-62% drums	lb.	.03 – .04
Sodium sulphite, crys., bbl.	lb.	.03½ – .03½
Strontium nitrate, powd., bbl.	lb.	.11½ – .12
Sulphur chloride, yel drums.	lb.	.04½ – .05
Sulphur, crude	ton	18.00 – 20.00
At mine, bulk	ton	16.00 – 18.00
Sulphur, flour, bag	100 lb.	2.25 – 2.35
Sulphur, roll, bag	100 lb.	2.00 – 2.10
Sulphur dioxide, liquid, cyl.	lb.	.08 – .08½
Tin bichloride, bbl.	lb.	.12½ – .13
Tin oxide, bbl.	lb.	.47 – ....
Tin crystals, bbl.	lb.	.32 – .32½
Zinc carbonate, bags	lb.	.14 – .14½
Zinc chloride, gran, bbl.	lb.	.06½ – .06½
Zinc cyanide, drums	lb.	.37 – .38
Zinc oxide, , lead free, bbl.	lb.	.08 – .08½
5% lead sulphate, bags	lb.	.07½ – ....
10 to 35 % lead sulphate, bags	lb.	.07 – ....
French, red seal, bags	lb.	.09½ – ....
French, green seal, bags	lb.	.10½ – ....
French, white seal, bbl.	lb.	.12 – ....
Zinc sulphate, bbl.	100 lb.	2.75 – 3.25

Coal-Tar Products

Alpha-naphthol, crude, bbl.	lb.	$0.60 – $0.70
Alpha-naphthol, ref., bbl.	lb.	.65 – .80
Alpha-naphthylamine, bbl.	lb.	.35 – 36
Aniline oil, drums	lb.	.16 – .16½
Aniline salts, bbl.	lb.	.23 – .23½
Anthracene, 80%, drums	lb.	.75 – .80
Anthracene, 80%, imp., drums, duty paid	lb.	.65 – .70
Anthraquinone, 25%, paste, drums	lb.	.80 – .85
Benzaldehyde U.S.P., carboys	lb.	1.50 – ....
f.f.c. drums	lb.	1.60 – ....
tech, drums	lb.	75 – ....
Benzene, pure, water-white, tanks, works	gal.	.23 – ....
Benzene, 90%, tanks, works	gal.	.21 – ....
Benzidine base, bbl.	lb.	.80 – .85
Benzidine sulphate, bbl.	lb.	.75 – ....
Benzoic acid, U.S.P., kegs	lb.	.80 – 80
Benzoate of soda, U.S.P., bbl.	lb.	.65 – 70
Benzyl chloride, 95-97%, ref., drums	lb.	.45 – ....
Benzyl chloride, tech., drums	lb.	.30 – .35
Beta-naphthol, tech., bbl.	lb.	.25 – .26
Beta-naphthylamine, tech.	lb.	.75 – .80
Cresol, U.S.P., drums	lb.	.25 – .29
Ortho-cresol, drums	lb.	.28 – .32
Cresylic acid, 97%, works drums	gal.	.75 – .85
95-97%, drums, works	gal.	.70 – .75
Dichlorbenzene, drums	lb.	.06 – .08
Diethylaniline, drums	lb.	.50 – .60
Dimethylaniline, drums	lb.	.40 – 41
Dinitrobenzene, bbl.	lb.	.19 – 20
Dinitrochlorbenzene, bbl.	lb.	.21 – .22
Dinitronaphthalen, bbl.	lb.	.30 – .32
Dinitrophenol, bbl.	lb.	.35 – .40
Dinitrotoluen, bbl.	lb.	.20 – .22
Dip oil, 25%, drums	gal.	.25 – .30
Diphenylamine, bbl.	lb.	.50 – .52
H-acid, bbl.	lb.	.75 – .80
Meta-phenylenediamine, bbl.	lb.	1.00 – 1.05
Michlers ketone, bbl.	lb.	3.00 – 3.50
Monochlorbenzene, drums	lb.	.08 – .10
Monoethylaniline, drums	lb.	.95 – 1.10
Naphthalene, flake, bbl.	lb.	.06 – .06½
Naphthalene, balls, bbl.	lb.	.06½ – .07
Naphthionate of soda, bbl.	lb.	.60 – .65
Naphthionic acid, crude, bbl.	lb.	.55 – .60
Nitrobenzene, drums	lb.	.09½ – .10½
Nitro-naphthalene, bbl.	lb.	.30 – .35
Nitro-toluene, drums	lb.	.13½ – .14½
N-W acid, bbl.	lb.	1.10 – 1.20
Ortho-amidophenol, kegs	lb.	2.30 – 2.35
Ortho-dichlorbenzene, drums	lb.	.15 – .17
Ortho-nitrophenol, bbl.	lb.	1.20 – 1.30
Ortho-nitrotoluene, drums	lb.	.10 – .12
Ortho-toluidine, bbl.	lb.	.17 – .18
Para-amiñophenol, base, kegs	lb.	1.30 – ....
Para-amiñophenol, HCl, kegs	lb.	1.55 – ....
Para-dichlorbenzene, bbl.	lb.	.17 – 20
Paranitroaniline, bbl.	lb.	.73 – .75
Para-nitrotoluene, bbl.	lb.	.60 – .65
Para-phenylenediamine, bbl.	lb.	1.45 – 1.50
Para-toluidine, bbl	lb.	.90 – .95
Phthalic anhydride, bbl.	lb.	.30 – .34
Phenol, U.S.P., dr.	lb.	.25 – .26
Picric acid, bbl.	lb.	.20 – .22
Pyridine, dom., drums	gal.	nominal
Pyridine, imp., drums	gal.	5.75 – 6.00
Resorcinol, tech., kegs	lb.	1.40 – 1.50

Resorcinol, pure, kegs	lb.	$2.15	
R-salt, bbl.	lb.	.55 –	.60
Salicylic acid, tech., bbl.	lb.	.32 –	....
Salicylic acid, U.S.P., bbl.	lb.	.35 –	....
Solvent naphtha, water-white, tanks	gal.	.23 –	....
Crude, tanks	gal.	.20 –	....
Sulphanilic acid, crude, bbl.	lb.	.18 –	.20
Thiocarbanilide, kegs	lb.	.35 –	.38
Tolidine, bbl	lb.	1.00 –	1.05
Toluidine, mixed, kegs	lb.	.30 –	.35
Toluene, tank cars, works	gal.	.24 –	....
Toluene, drums, works	gal.	.29 –	....
Xylidine, drums	lb.	.50 –	....
Xylene, pure, drums	gal.	.50 –	.55
Xylene, com., drums	gal.	.34 –	....
Xylene, com., tanks	gal.	.29 –	....

Naval Stores

Rosin B-D, bbl.	280 lb.	$5.80 –	.....
Rosin E-I, bbl.	280 lb.	5.80 –	.....
Rosin K-N, bbl.	280 lb.	5.85 –	$6.10
Rosin W.G.-W.W., bbl.	280 lb.	6.65 –	7.00
Wood rosin, bbl.	280 lb.	5.90 –	6.00
Turpentine, spirits of, bbl.	gal.	.96 –	.....
Wood, steam dist., bbl.	gal.	.90 –	.....
Wood, dest. dist., bbl.	gal.	.75 –	.....
Pine tar pitch, bbl.	200 lb.	5.50 –	.....
Tar, kiln burned, bbl.	500 lb.	11.00 –	.....
Retort tar, bbl.	500 lb.	11.00 –	.....
Rosin oil, first run, bbl.	gal.	.45 –	.....
Rosin oil, second run, bbl.	gal.	.47 –	.....
Rosin oil, third run, bbl.	gal.	.50 –	.....
Pine oil, steam dist.	gal.	.65 –	.....
Pine oil, pure, dest. dist.	gal.	.60 –	.....
Pine tar oil, ref.	gal.	.48 –	.....
Pine tar oil, crude, tanks f.o.b. Jacksonville, Fla.	gal.	.32 –	.32½
Pine tar oil, double ref., bbl.	gal.	..... –	.75
Pine tar, ref., thin, bbl.	gal.	..... –	.25
Pinewood creosote, ref., bbl.	gal.	..... –	.52

Animal Oils and Fats

Degras, bbl.	lb.	$0.04 –	$0.04½
Grease, yellow, bbl.	lb.	.06½ –	.06¼
Lard oil, Extra No. 1, bbl.	gal.	.86 –	.88
Neatsfootoil, 20 deg. bbl.	gal.	1.30 –	.....
No. 1, bbl.	gal.	.94 –	.96
Oleo Stearine	lb.	.11½ –	.....
Oleo oil, No. 1, bbl.	lb.	.14½ –	.15
Red oil, distilled, d.p. bbl.	lb.	.08½ –	.08¾
Saponified, bbl.	lb.	.08½ –	.08¾
Tallow, extra, loose	lb.	.08 –	.....
Tallow oil, acidless, bbl.	gal.	.86½ –	.87

Vegetable Oils

Castor oil, No. 3, bbl.	lb.	$0.13 –	.....
Castor oil, No. 1, bbl.	lb.	.13½ –	.....
Chinawood oil, bbl.	lb.	.21 –	.21½
Cocoanut oil, Ceylon, bbl.	lb.	.09½ –	.09¾
Ceylon, tanks, N.Y.	lb.	.08½ –	.08¾
Cocoanut oil, Cochin, bbl.	lb.	.09¾ –	.10
Corn oil, crude, bbl.	lb.	.11½ –	.....
Crude, tanks, (f.o.b. mill)	lb.	.10½ –	.....
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	.10½ –	.....
Summer yellow, bbl.	lb.	.13½ –	.13¾
Winter yellow, bbl.	lb.	.13½ –	.13¾
Linseed oil, raw, car lots, bbl.	gal.	.90 –	.....
Raw, tank cars (dom.)	gal.	.84 –	.....
Boiled, cars, bbl. (dom.)	gal.	.92 –	.....
Olive oil, denatured, bbl.	gal.	1.10 –	1.12
Sulphur, (foots) bbl.	lb.	.08½ –	.08¾
Palm, Lagos, casks	lb.	.07½ –	.07¾
Niger, casks	lb.	.07½ –	.....
Palm kernel, bbl.	lb.	.08½ –	.08¾
Peanut oil, crude, tanks (mill)	lb.	.11 –	.....
Peanut oil, refined, bbl.	lb.	.14 –	.....
Perilla, bbl	lb.	.14½ –	.14½
Rapeseed oil, refined, bbl.	gal.	.73 –	.75
Rapeseed oil, blown, bbl.	gal.	.82 –	.....
Sesame, bbl	lb.	.13 –	.13¼
Soya bean (Manchurian), bbl.	lb.	.11 –	.....
Tank, f.o.b. Pacific coast	lb.	.09½ –	.....
Tank, (f.o.b. N.Y.)	lb.	.10¼ –	.....

Fish Oils

Cod, Newfoundland, bbl.	gal.	$0.68 –	.....
Menhaden, light pressed, bbl.	gal.	.64 –	.....
White bleached, bbl.	gal.	.66 –	.....
Blown, bbl.	gal.	.70 –	.....
Crude, tanks (f.o.b. factory	gal.	.50 –	.....
Whale No. 1 crude, tanks, coast	lb.	..... –	.....
Winter, natural, bbl.	gal.	.75 –	.76
Winter, bleached, bbl.	gal.	.78 –	.79

Oil Cake and Meal

Cocoanut cake, bags	ton	$32.00 –	$33.00
Copra, sun dried, bags, (c.i.f.)	lb.	.05¼ –	.....
Sun dried Pacific coast	lb.	.04½ –	.05¼
Cottonseed meal, f.o.b. mills	ton	40.00 –	41.00
Linseed cake, bags	ton	40.00 –	.....
Linseed meal, bags	ton	44.00 –	.....

Dye & Tanning Materials

Albumen, blood, bbl.	lb.	$0.45 –	$0.50
Albumen, egg, tech, kegs	lb.	.95 –	.97
Cochneal, bags	lb.	.32 –	.34
Cutch, Borneo, bales	lb.	.04 –	.04½
Cutch, Rangoon, bales	lb.	.15 –	.16
Dextrine, corn, bags	100 lb.	4.14 –	4.19
Dextrine gum, bags	100 lb.	4.44 –	4.71
Divi-divi, bags	ton	38.00 –	39.00
Fustic, sticks	ton	30.00 –	35.00
Fustic, chips, bags	lb.	.04 –	.05
Gambier com. cs	lb.	.08½ –	.09
Logwood, sticks	ton	25.00 –	26.00
Logwood, chips, bags	lb.	.02½ –	.03
Sumac, leaves, Sicily, bags	ton	80.00 –	85.00
Sumac, ground, bags	ton	$75.00 –	$80.00
Sumac, domestic, bags	ton	40.00 –	42.00
Starch, corn, bags	100 lb.	3.57 –	3.67
Tapioca flour, bags	lb.	.07 –	.07½

Extracts

Archil, conc., bbl.	lb.	$0.16½ –	$0.20
Chestnut, 25% tannin, tanks	lb.	.02 –	.03
Divi-divi, 25% tannin, bbl.	lb.	.04 –	.05
Fustic, crystals, bbl.	lb.	.20 –	.22
Fustic, liquid, 42°, bbl.	lb.	.08 –	.09
Gambier, liq., 25% tannin, bbl.	lb.	.09 –	.09½
Hematine crys., bbl.	lb.	.14 –	.18
Hemlock, 25% tannin, bbl.	lb.	.03½ –	.04
Hypernic, solid, drums	lb.	.24 –	.26
Hypernic, liquid, 51°, bbl.	lb.	.09½ –	.10½
Logwood, crys., bbl.	lb.	.14 –	.15
Logwood, liq., 51°, bbl.	lb.	.07½ –	.08
Quebracho, solid, 65% tannin, bbl.	lb.	.04½ –	.05
Sumac, dom., 51°, bbl.	lb.	.06½ –	.07½

Dry Colors

Blacks–Carbongas, bags, f.o.b. works, spot	lb.	$0.14 –	$0.18
Lampblack, bbl.	lb.	.12 –	.40
Mineral, bulk	ton	35.00 –	45.00
Blues–Bronze, bbl.	lb.	.45 –	.50
Prussian, bbl.	lb.	.45 –	.50
Ultramarine, bbl.	lb.	.08 –	.35
Browns, Sienna, Ital., bbl.	lb.	.06 –	.14
Sienna, Domestic, bbl.	lb.	.03½ –	.04
Umber, Turkey, bbl.	lb.	.04 –	.04½
Greens–Chrome, C.P. Light, bbl.	lb.	.28 –	.30
Chrome, commercial, bbl.	lb.	.12 –	.12½
Paris, bulk	lb.	.28 –	.30
Reds Carmine No. 40, tins	lb.	4.50 –	4.70
Oxide red, casks	lb.	.10 –	.14
Para toner, kegs	lb.	1.00 –	1.10
Vermilion, English, bbl.	lb.	1.15 –	1.20
Yellow, Chrome, C.P. bbls.	lb.	.17 –	.....
Ocher, French, casks	lb.	.02½ –	.03

Waxes

Bayberry, bbl.	lb.	$0.25 –	$0.26
Beeswax, crude, Afr. bg.	lb.	.22 –	.....
Beeswax, refined, light, bags	lb.	.32 –	.34
Beeswax, pure white, cases	lb.	.40 –	.41
Candelilla, bags	lb.	.23½ –	.24
Carnauba, No. 1, bags	lb.	.36 –	.38
No. 2, North Country, bags	lb.	.23½ –	.24
No. 3, North Country, bags	lb.	.16½ –	.17
Japan, cases	lb.	.16 –	.16½
Montan, crude, bags	lb.	.05 –	.....
Paraffine, crude, match, 105-110 m.p., bbl.	lb.	.04½ –	.04½
Crude, scale 124-126 m.p. bags	lb.	.03 –	.....
Ref., 118-120 m.p., bags	lb.	.03½ –	.....
Ref., 125 m.p., bags	lb.	.03¾ –	.....
Ref. 128-130 m.p., bags	lb.	.04 –	.....
Ref., 133-135 m.p., bags	lb.	.04½ –	.05
Ref., 135-137 m.p., bags	lb.	.05½ –	.....
Stearic acid, sgle pressed, bags	lb.	.12½ –	.12¾
Double pressed, bags	lb.	.13 –	.13¼
Triple pressed, bags	lb.	.14½ –	.14½

Fertilizers

Ammonium sulphate, bulk f.o.b. works	100 lb.	$3.20 –	$3.25
F.a.s. double bags	100 lb.	3.40 –	3.50
Blood, dried, bulk	unit	4.40 –	4.60
Bone, raw, 3 and 50, ground	ton	28.00 –	30.00
Fish scrap, dom., dried, wks.	unit	..... –	.....
Nitrate of soda, bags	100 lb.	2.45 –	2.52½
Tankage, high grade, f.o.b. Chicago	unit	3.25 –	3.35
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	4.00 –	4.50
Tennessee, 78-80%	ton	7.75 –	8.00
Potassium muriate, 80% bags	ton	34.55 –	.....
Potassium sulphate, bags basis 90%	ton	43.67 –	.....
Double manure salt	ton	25.72 –	.....
Kainit	ton	7.22 –	.....

Crude Rubber

Para—Upriver fine	lb.	$0.22 –	.....
Upriver coarse	lb.	.17½ –	.....
Upriver caucho ball	lb.	.18½ –	.....
Plantation—First latex crepe	lb.	.27 –	.....
Ribbed smoked sheets	lb.	.26½ –	.....
Brown crepe, thin, clean	lb.	.25 –	.....
Amber crepe No. 1	lb.	.25½ –	.....

Gums

Copal, Congo, amber, bags	lb.	$0.10 –	$0.15
East Indian, bold, bags	lb.	.21 –	.22
Manila, pale, bags	lb.	.19 –	.20
Pontinak, No. 1 bags	lb.	.19 –	.20
Damar, Batavia, cases	lb.	.24½ –	.25
Singapore, No. 1, cases	lb.	.32 –	.33
Singapore, No. 2, cases	lb.	.21½ –	.22
Kauri, No. 1, cases	lb	.64 –	.66
Ordinary chips, cases	lb.	.21 –	.23
Manjak, Barbados, bags	lb.	.09 –	.14

Shellac

Shellac, orange fine, bags	lb.	$0.64 –	$0.65
Orange superfine, bags	lb.	.66 –	.67
A. C. garnet, bags	lb.	.65 –	.....
Bleached, bonedry	lb.	.72 –	.73
Bleached, fresh	lb.	.60 –	.....
T. N., bags	lb.	.61 –	.....

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec	sh ton	$350.00 –	$450.00
Asbestos, shingle, f.o.b., Quebec	sh. ton	$50.00 –	$60.00
Asbestos, cement, f.o.b., Quebec	sh. ton	17.00 –	20.00
Barytes, grd., white, f.o.b. mills, bbl.	net ton	15.00 –	18.00
Barytes, grd., off-color, f.o.b. Balt.	net ton	12.00 –	14.00
Barytes, floated, f.o.b. St. Louis, bbl.	net ton	26.00 –	.....
Barytes, crude f.o.b. mines, bulk	net ton	8.00 –	10.00
Casein, bbl., tech	lb.	.12½ –	.14
China clay (kaolin) crude, f.o.b. Ga.	net ton	6.00 –	8.00
Washed, f.o.b. Ga.	net ton	8.00 –	9.00
Powd., f.o.b. Ga.	net ton	14.00 –	20.00
Crude f.o.b. Va.	net ton	6.00 –	8.00
Ground, f.o.b. Va.	net ton	13.00 –	19.00
Imp., lump, bulk	net ton	15.00 –	20.00
Imp., powd.	net ton	45.00 –	50.00
Feldspar, No. 1 pottery	long ton	7.00 –	8.00
No. 2 pottery	long ton	6.00 –	.....
No. 1 soap	long ton	8.50 –	.....
No. 1 Canadian, f.o.b. mill, powd.	long ton	20.00 –	.....
Graphite, Ceylon, lump, first quality, bbl.	lb.	.06 –	.06½
Ceylon, chip, bbl.	lb.	.04½ –	.05
High grade amorphous crude	ton	15.00 –	30.00
Gum arabic, amber, sorts, bags	lb.	.13½ –	.14½
Gum tragacanth, sorts, bags	lb.	.50 –	.55
No. 1, bags	lb.	1.40 –	1.45
Kieselguhr, f.o.b. Cal.	ton	40.00 –	42.00
F.o.b. N. Y.	ton	50.00 –	55.00
Magnesite, crude, f.o.b. Cal.	ton	14.00 –	15.00
Pumice stone, imp., casks	lb.	.03 –	.05½
Dom., lump, bbl.	lb.	.05 –	.05½
Dom., ground, bbl.	lb.	.05½ –	.06
Silica, glass sand, f.o.b. Ind.	ton	2.00 –	2.50
Silica, sand blast, f.o.b. Ind.	ton	2.50 –	5.00
Silica, amorphous, 200-mesh, f.o.b. Ill.	ton	20.00 –	.....
Silica, glass sand, f.o.b. Ill.	ton	1.50 –	3.00
Soapstone, coarse, f.o.b. Vt., bags	ton	7.00 –	8.00
Talc, 200 mesh, f.o.b., Vt., bags, extra	ton	6.50 –	8.50
Talc, 200 mesh, f.o.b. Ga., bags	ton	7.00 –	9.00
Talc, 350 mesh, f.o.b. New York, grade A bags	ton	22.00 –	.....

Mineral Oils

Crude, at Wells

Pennsylvania	bbl.	$2.50 –	2.75
Corning	bbl.	1.45 –	.....
Cabell	bbl.	1.35 –	.....
Somerset	bbl.	1.25 –	.....
Illinois	bbl.	1.22 –	.....
Indiana	bbl.	1.48 –	.....
Kansas and Oklahoma, 28 deg.	bbl.	.50 –	.....
California, 35 deg. and up	bbl.	.76 –	.....

Gasoline, Etc.

Motor gasoline, steel bbls.	gal.	$0.16½ –	.....
Naphtha, V. M. & P. deod, steel bbls.	gal	.15½ –	.....
Kerosene, ref. tank wagon	gal.	.14 –	.....
Bulk, W.W. delivered, N.Y.	gal.	.06 –	.....
Lubricating oils:			
Cylinder, Penn., dark	gal.	.22½ –	.....
Bloomless, 30@31 grav.	gal.	.17½ –	.....
Paraffin, pale	gal.	.16 –	.17
Spindle, 200, pale	gal.	.20 –	.20½
Petrolatum, amber, bbls.	lb.	.03½ –	.04
Paraffine wax (see waxes)			

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	1,000	$140–145	
Chrome brick, f.o.b. Eastern shipping points	ton	50–52	
Chrome cement, 40-50% Cr_2O_3	ton	23–27	
40-45% Cr_2O_3, sacks, f.o.b. Eastern shipping points	ton	23.00	
Fireclay brick, 1st. quality, 9-in. shapes, f.o.b. Ky. wks.	1,000	42–45	
2nd. quality, 9-in. shapes, f.o.b. wks.	1,000	35–38	
Magnesite brick, 9-in. straight (f.o.b. wks.)	ton	65–68	
9-in. arches, wedges and keys	ton	80–85	
Scraps and splits	ton	85	
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	50–53	
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	50–53	
F.o.b. Mt. Union, Pa.	1,000	42–45	
Silicon carbide refract. brick, 9-in.	1,000	950.00	

Ferro-Alloys

Ferrotitanium, 15-18% f.o.b. Niagara Falls, N.Y.	ton	$200.00 –	$225.00
Ferrochromium, per lb. of Cr, 1-2% C	lb.	.28 –	.30
4-6% C	lb.	.12 –	...
Ferromanganese, 78-82% Mn, Atlantic seabd. duty paid	gr. ton	110.00 –	.....
Spiegeleisen, 19-21% Mn.	gr. ton	42.00 –	45.00
Ferromolybdenum, 50-60% Mo, per lb. Mo	lb.	2.00 –	2.50
Ferrosilicon, 10-12%	gr. ton	43.00 –	50.00
50%	gr. ton	82.50 –	85.00

Ferrotungsten, 70–80%, per lb. of W	lb.	$0.88 @ $0.90
Ferro-uranium, 35-50% o f U. per lb. of U	lb.	4.50 – ....
Ferrovanadium, 30-40%, per lb. of V	lb.	3.50 – 4.50

Ores and Semi-finished Products

Bauxite, dom. crushed dried, f.o.b. shipping points	ton	$5.50 – $8.75
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	22.00 – 23.00
C.i.f. Atlantic seaboard	ton	19.50 – 21.50
Coke, fdry., f.o.b. ovens	ton	5.00 – 5.50
Coke, furnace, f.o.b. ovens	ton	3.75 – 4.00
Fluorspar, gravel, f.o.b. mines' Illinois	ton	23.50 – .....
Ilmenite, 52% TiO_2	lb.	.00½ – .01
Manganese ore, 50% Mn c.i.f. Atlantic seaport	unit	.39 – .42
Manganese ore, chemical (MnO_2)	ton	75.00 – 80.00
Molybdenite, 85% MoS_2, per lb. MoS_2, N. Y.	lb.	.75 – .....
Monazite, per unit of ThO_2, c.i.f., Atl. seaport	lb.	.06 – .08
Pyrites, Span., fines, c.i.f Atl. seaport	unit	.11½ – .12
Pyrites, Span., furnace size c.i.f. Atl. seaport	unit	.11½ – .12
Pyrites, dom. fines, f.o.b. mines, Ga.	unit	.12 – .....
Rutile, 95% TiO_2	lb.	.10 – .....
Tungsten, scheelite, 60% WO_3 and over	unit	9.50 – 10.00
Tungsten, wolframite, 60% WO_3	unit	8.50 – 9.00
Uranium ore (carnotite) per lb. of U_3O_8	lb.	3.50 – 3.75
Uranium oxide, 96% per lb. U_3O_8	lb.	2.25 – 2.50
Vanadium pentoxide, 99%	lb.	12.00 – 14.00
Vanadium ore, per lb. V_2O_5	lb.	.75 – 1.00
Zircon	ton	80.00 – .....

Non-Ferrous Materials

	Cents per Lb.
Copper, electrolytic	12½
Aluminum, 98 to 99%	25–27
Antimony, wholesale, Chinese and Japanese	9½
Nickel, 99%	27–32
Monel metal, shot and blocks	32.00
Monel metal, ingots	38.00
Monel metal, sheet bars	45.00
Tin, 5-ton lots, Straits	43.37½
Lead, New York, spot	6.75
Lead, E. St. Louis, spot	6.45
Zinc, spot, New York	6.70
Zinc, spot, E. St. Louis	6.35

Other Metals

Silver (commercial)	oz.	$0.63½
Cadmium	lb.	.75@.80
Bismuth (500 lb. lots)	lb.	2.55
Cobalt	lb.	3.00-3.25
Magnesium, ingots, 99%	lb.	1.25– ....
Platinum	oz.	120.00
Iridium	oz.	275.00@300.00
Palladium	oz.	80.00
Mercury	75 lb.	62.00
Tungsten	lb.	.97–1.00

Finished Metal Products

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	19.25
Copper bottoms	29.75
Copper rods	19.75
High brass wire	18.00
High brass rods	15.75
Low brass wire	20.25
Low brass rods	20.50
Brazed brass tubing	23.50
Brazed bronze tubing	27.00
Seamless copper tubing	25.50
Seamless high brass tubing	24.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	9.00@ 9.50
Copper, heavy and wire	10.25@10.50
Copper, light and bottoms	8.50@ 8.75
Lead, heavy	5.50@ 5.62½
Lead, tea	3.50@ 3.75
Brass, heavy	6.00@ 6.25
Brass, light	5.25@ 5.50
No. 1 yellow brass turnings	5.75@ 6.00
Zinc scrap	3.75@ 4.00

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$3.54	$3.54
Soft steel bars	3.54	3.54
Soft steel bar shapes	3.54	3.54
Soft steel bands	4.39	4.39
Plates, ¼ to 1 in. thick	3.64	3.64

Industrial

Financial, Construction and Manufacturing News

Construction and Operation

Alabama

BIRMINGHAM—The Benson Paint & Varnish Co., 2317 1st Ave., has preliminary plans under way for extensions and improvements in its plant, with the installation of additional equipment for increased output. K. Y. Benson is president.

California

LOST HILLS—The Vanderuff Petroleum Co., Inc., San Diego, Calif., is planning for the construction of a new plant in the vicinity of Lost Hills, near Wasco, for the manufacture of various petroleum byproducts. It will include a department for the production of ammonia sulphate and is estimated to cost close to $50,000. Plans are also projected for a new refining plant in this same location with initial capacity of about 250 bbl. per day. W. S. Hillyer is superintendent.

COMPTON—The Samson Tire & Rubber Corp. is perfecting plans for enlargements in its plant to provide about 50,000 sq.ft. of additional floor area. It is purposed to install equipment to double the present output. Adolph Schleicher is president.

SAN FRANCISCO—The Standard Sanitary Mfg. Co., Bessemer Bldg., Pittsburgh, Pa., manufacturer of enameled iron sanitary ware, vitreous china products, etc., has awarded a general contract to Cahill Brothers, 110 Sutter St., for the erection of a new local factory branch at 9th and Brannan Sts., to be 5-story, 100x180 ft., estimated to cost $285,000. Weeks & Day, 315 Montgomery St., are architects.

NATIONAL CITY—Spreckels Brothers Commercial Co., San Diego, has preliminary plans under way for the construction of a new plant on 24th St., National City, fronting on the line of the San Diego & Arizona Railway, consisting of a group of buildings, for the manufacture of waterproof paints, composition building board and kindred specialties. A separate plant unit will also be built for the manufacture of commercial fertilizers. The reported cost of the new works is placed at $125,000, including equipment. Claus Spreckels is vice-president and general manager.

THREE RIVERS—The San Joaquin Portland Cement Co., organized by F. A. Parker and Herbert Coffman, officials of the Old Mission Portland Cement Co., 608 Crocker Bldg., San Francisco, has tentative plans under advisement for the construction of a new plant on site selected near Three Rivers, to consist of a number of units, equipped for an initial capacity of 3,500 bbl. per day, estimated to cost in excess of $650,000, with machinery.

Florida

KELSEY CITY—The American Fiber Co., recently formed with a capital of $500,000, has preliminary plans under way for the erection of a new local plant for the manufacture of fiber products, estimated to cost in excess of $75,000, with equipment. William H. Power, West Palm Beach, Fla., is secretary and treasurer.

Georgia

ATLANTA—The Kershaw, Lancaster & Marion Oil Mills Co., Kershaw, S. C., has purchased the cottonseed oil mills and other property of the American Cotton Oil Co., at Atlanta, Augusta and Macon, Ga., and Montgomery and Huntsville, Ala., and will take possession at an early date. The new owner plans for the operation of the different plants at a later date and contemplates necessary improvements for full capacity. John T. Stevens is president.

Illinois

CHICAGO—The George H. Morrill Co., 157 West Harrison St., manufacturer of printing and other inks, has taken title to a tract of property comprising about 3½ acres of land on South Melvina St., between 65th and 66th Sts., Clearing Industrial District, as a site for its proposed new plant, to consist of two units, 1- and 2-story, 40x250 ft. and 40x52 ft., respectively. Foltz & Brand, 111 West Washington St., are architects.

CHICAGO—The Crane Co., 836 South Michigan Ave., manufacturer of sanitary ware, enameled iron products, etc., will soon take bids for the erection of a 2-story foundry, 160x500 ft., at 4100 South Kedzie St., estimated to cost about $850,000, with equipment. Graham, Anderson, Probst & White, 80 East Jackson Blvd., are architects.

Indiana

INDIANA HARBOR—The Youngstown Sheet & Tube Co., Youngstown, O., will soon commence the erection of a new blast furnace at the local works of the Steel & Tube Co. of America, Inc., recently acquired, and now being operated as a subsidiary. It will have a rated capacity of 600 tons. The company will also construct two new mills for the production of buttweld pipe, making a total of 22 such units at the works. The expansion is estimated to cost close to $4,000,000. James A. Campbell is president.

COLUMBUS—The Indiana Oil Refining Co. is perfecting plans for an appropriation of $125,000, authorized by stockholders, to be used for extensions and improvements at the plant.

Louisiana

NEW ORLEANS—The Loubat Glassware & Cork Co., 516 Bienville St., has tentative plans under consideration for the rebuilding of the portion of its local works, recently destroyed by fire with loss estimated at $250,000, including equipment and buildings.

Maryland

FAIRFIELD—The United States Industrial Chemical Co., 110 East 42nd St., New York, has construction in progress on a new plant at Fairfield, near Baltimore, to be used primarily for the production of ammonia and potash, consisting of individual units for each of these branches of manufacture. Contracts for the buildings have been let to William G. Gischel & Co., Curtis Bay, and the Curtis Bay Copper & Iron Works. The estimated cost is placed in excess of $750,000, with equipment. The company also has plans in progress for the construction of a new fertilizer plant, to be located on adjoining site in this same district, on which work will be started as soon as the other structures are completed. It is expected to cost more than $300,000, including mixing and other machinery.

BALTIMORE—The Bethlehem Steel Corp., Bethlehem, Pa., has preliminary plans under advisement for extensions in the tinplate works at its local Sparrows Point mills. It is purposed to construct a number of hot mills, to double, approximately, the present capacity. A definite decision as to time of building will likely be deferred until early in the coming year.

BALTIMORE—The Maryland Glass Co. has filed plans for the erection of two new buildings at its works at Linden and Orleans Sts., 100x120 ft., and 60x140 ft., to cost approximately $60,000. Contract for construction recently was awarded to the Austin Co., Cleveland, O.

Massachusetts

WOBURN—The Chapel Leather Co., Bedford Road, has tentative plans under advisement for the rebuilding of the portion of its local works, destroyed by fire, Oct. 25, with loss estimated at $40,000.

SOMERVILLE—Fire, Oct. 29, destroyed a portion of the plant of the Union Glass Works, Webster St., with loss estimated at $12,000.

Michigan

DETROIT—The Stone Enameling Co., 1831 West Fort St., has filed plans for the erection of a 1-story addition to its plant at 2515 Scotten St., estimated to cost $13,000.

Minnesota

GRANITE FALLS—The city council has commissioned W. E. Buell & Co., 205 Davidson Bldg., Sioux City, Ia., consulting engineers, to prepare plans for the construction of a new filtration plant, estimated to cost $50,000. It is purposed to call for bids at an early date.

Missouri

ST. LOUIS—The B. J. Mullikin Tire Co., Times Bldg., recently organized with a capital of $250,000, has acquired a local 6-story building for the establishment of a new plant, and plans for the early installation of equipment and occupancy. B. J. Mullikin is president and general manager.

BISMARCK—The Ford Motor Co., Highland Park, Detroit, Mich., has acquired local lead properties, heretofore held by the Irondale Lead Mines Co. Plans are under consideration for the early installation of necessary equipment and the operation of a lead works, with output to be used in connection with automobile production at the main plants of the company.

New Jersey

NEWARK—The W. F. Devoe & C. T. Raynolds Co., 223 New Jersey Railroad Ave., manufacturer of paints, varnishes, etc., will commence the erection of a new 4-story addition to its plant at 34-36 Oliver St., estimated to cost $50,000, including improvements in the present structure.

JERSEY CITY — The American Rubber Products Co. has acquired the former plant of the American Butterine Co., at Henderson and 8th Sts., totaling 100x250 ft., and will remodel and improve the structure for a new works for the manufacture of a line of rubber specialties for plumbing and other service. Equipment will be installed at an early date.

GLOUCESTER CITY—The Armstrong Cork Co., Camden, N. J., with headquarters at Pittsburgh, Pa., has acquired the former local plant of the Argo Mills, Inc., heretofore used as a textile mill. The new owner is said to be planning for improvements and alterations, with intention to occupy as a branch works in the near future.

New York

DEFERIET—The St. Regis Paper Co., Trust Building, Watertown, N. Y., has preliminary plans under way for the erection of a new local plant, to consist of a number of units, with power house, estimated to cost close to $500,000, including machinery.

DUNKIRK—The Atlas Steel Corp., comprising a recent merger of the Atlas Crucible Steel Co. and the Electric Alloy Steel Co., is arranging a fund of $400,000, the proceeds to be used for extensions and improvements in its plant, including the installation of additional equipment. L. J. Campbell is president.

PLATTSBURGH—The Saranac Pulp & Paper Co., recently organized, has taken over the former local plant of the Lozier Automobile Co., for the establishment of a new paper mill. The structure will be remodeled and improved, and equipment installed at an early date. H. P. G. Nostrand, formerly connected with the Stevens & Thompson Paper Co., Greenwich, N. Y., is general manager.

North Dakota

MINOT—The Minot Starch Co. will hold in temporary abeyance the erection of its proposed new 3-story plant, estimated to cost approximately $45,000, for which plans have recently been prepared by Bell & Kinports, 1624 Harmon Place, Minneapolis, Minn., architects. F. A. Youngman is secretary.

Ohio

CARROLLTON—The Albright China Co. has acquired property heretofore held by the Tuscan Rubber Co. and will use as a site for the erection of a new addition, to consist of 4 kilns and miscellaneous structures.

DEFIANCE—The Central Rubber Co. has tentative plans for the rebuilding of the portion of its plant recently destroyed by fire. An official estimate of loss has not been announced.

ZANESVILLE—The Art Brick & Construction Co., recently organized, is perfecting plans for the erection of a new plant in the Licking View section for the manufacture of concrete blocks, cement brick, etc., consisting of a main 2-story structure, estimated to cost $40,000, with equipment. Guy H. Blackburn is general manager.

Pennsylvania

PITTSBURGH—The Pennsylvania Lubricating Co., 34th and Smallman Sts., manufacturer of oils, greases, etc., has awarded a general contract to the Coutts Co., 3320 Smallman St., for the erection of a new 2-story addition, 50x120 ft., estimated to cost approximately $35,000.

TITUSVILLE—Fire, Oct. 29, destroyed a portion of one of the refinery buildings of the American Oil Works, with loss reported at $45,000. It is planned to rebuild.

Rhode Island

PROVIDENCE — The Davol Rubber Co., South St., has awarded a general contract to O. D. Purington & Co., Providence, for the erection of a 3-story addition to its plant, 115x170 ft., to be equipped for general manufacture. F. P. Sheldon & Son, Providence, are engineers.

Tennessee

GREENFIELD—The Tennessee Cotton Oil Co., Jackson, Tenn., is planning for the rebuilding of the portion of its local mill, recently destroyed by fire with loss estimated at $25,000, including equipment. The company will soon commence the erection of additional buildings at its Jackson works.

Texas

RANGER—Fire, Oct. 29, destroyed a large portion of the local refining plant of the Chestnutt & Smith Corp., Tulsa, Okla., with loss estimated at close to $500,000, including equipment. It is planned to rebuild.

Virginia

ROANOKE—The Roanoke Gas Light Co. has preliminary plans for extensions and improvements in its gas-manufacturing plant and system, to include the installation of additional equipment, instruments, etc.

West Virginia

WARDENSVILLE—The Wardensville Paint & Mineral Co., recently organized with a capital of $100,000, is perfecting plans for the erection of a new local plant for the manufacture of paints and affiliated products. C. N. Rauck is president, and A. L. Calvert, secretary.

CHARLESTON — The Jaunda Mining Co., 713 Virginia St., recently formed with a capital of $130,000, has plans in progress for the development of local mineral lands and purposes to install complete mining and operating machinery. It is expected to call for equipment bids late in December. C. W. Estep is president.

New Companies

NATIONAL GLASS & LENS CO., Lancaster, O.; glass products; $75,000. Incorporators: J. L. Graham, C. S. Hutchinson, Charles H. Hamilton and Albert Steiner, all of Lancaster.

GLORIENT, INC., New York, N. Y.; chemicals, chemical byproducts, dyes, etc.; $100,000. Incorporators: H. P. Morris, V. L. Woodward and S. M. Lack. Representative: Whitman, Ottinger & Ransom, 120 Broadway, New York.

HENDERSON COTTON OIL CO., Henderson, N. C.; cottonseed oil products; $215,000. Incorporators: D. Boyd Kimball, Jr., and S. R. Chavasse, both of Henderson.

PALMER CALCITE CO., Texas (Baltimore County), Md.; to operate limestone properties and reduction plants; $400,000. Incorporators: Richard E. Tome, Carville D. Benson, Jr., and Thomas W. Welsh, Texas.

AMERICAN RADIAC CO., Marion, Ind.; chemicals and chemical byproducts; $10,000. Incorporators: Thomas J. Tims, D. H. Blumenthal and William H. Jones, all of Marion.

UNION WAXED & TISSUE PAPER CO., INC., Newark, N. J.; waxed and other paper products; 6,000 shares of stock, no par value. Incorporators: Rae W. Shapiro and R. Flaster. Representative: Bilder & Bilder, 790 Broad St., Newark.

ADVANCE BRONZE CO., Springfield, Mass.; bronze, brass and kindred metal products; $50,000. Charles H. Atkins is president; and Frederick F. Isaacs, Leyfred Terrace, Springfield, treasurer.

AMERICAN PAINT CO., Philadelphia, Pa.; paints, varnishes, etc.; organized under Delaware laws. Representative: Corporation Guarantee & Trust Co., Land Title Bldg., Philadelphia.

UNIVERSAL SOAP MFG. CO., New York, N. Y.; soaps, washing compounds, etc.; $50,000. Incorporators: N. Allen and G. A. Vardalachos. Representative: Hirschman & Roeder, 1475 Broadway, New York.

RAUSCHER LIME CO., Erwin, Tenn.; hydrated lime and kindred products; $25,000. Incorporators: E. W. Rauscher, Jr., and W. R. Wyatt, both of Erwin.

BUCKEYE BRONZE CASTING CO., Toledo, O.; brass and bronze castings, etc.; $10,000. Incorporators: George Bennett and George B. Thomas, both of Toledo.

ALCHEMY PRODUCTS CORP., Wilmington, Del.; chemicals and chemical byproducts; $50,000. Representative: Corporation Trust Co. of America, Wilmington.

AMERICAN FUSED SILICA CORP., New Brunswick, N. J.; fused silica products; 10,000 shares of stock, no par value. Incorporators: Richard F. Ritter, Paul W. Ewing and Whitfield Farrington, 101 Albany St., New Brunswick. The last noted is representative.

CEYLON RUBBER PRODUCTS, INC., Boston, Mass.; rubber goods; $50,000. Arundel W. Faulkner is president, and Arthur H. Holbrook, Randolph, Mass., is treasurer.

ROBERT F. GRADY INK CO., 635 South Clark St., Chicago, Ill.; inks and kindred products; $20,000. Incorporators: Robert F. Grady and Hugh McGary.

GOLD SEAL SHELLAC CO., New York, N. Y.; shellac, varnishes, etc.; $20,000. Incorporators: N. and R. Dickstein, and H. Cohen. Representative: B. E. Kopelman, 280 Broadway, New York.

NITRO SOAP WORKS, INC., Nitro, W. Va.; soaps, washing compounds, etc.; $15,000. Incorporators: Walter A. and Frank A. Rebhan, Nitro.

WESTFIELD GRINDING WHEEL CO., Westfield, Mass.; abrasive materials, grinding wheels, etc.; $150,000. George L. Gaylord is president and treasurer.

LILY WHITE OIL CORP., Wilmington, Del.; refined oil products; $400,000. Representative: Corporation Trust Co. of America, du Pont Bldg., Wilmington.

PROTEX PAPER PRODUCTS CO., Brooklyn, N. Y.; paper goods; $25,000. Incorporators: A. Stone, M. Frost, and S. Friedman. Representative: Konnoson & Konnoson, 170 Broadway, New York.

SUPERIOR CARBON CO., INC., Wilmington, Del.; carbon black, etc.; $2,200,000. Representative: Corporation Service Co., Equitable Bldg., Wilmington.

RIGHT POLISH CO., Newark, N. J.; metal polishes, etc.; $50,000. Incorporators: Alexander Hagen, Hoffman and William S. Potter, 132 New Jersey Railroad Ave., Newark. The last noted is representative.

Industrial Notes

THE SCHAEFFER & BUDENBURG MFG. CO' has changed its name to the American Schaeffer & Budenberg Corp.

THE FILES TEMPERATURE CONTROL CO., INC., has just been formed as a subsidiary of the Files Engineering Co., Inc., of Bridgeport, Conn. The executive offices of the company are in Providence, and a business office is in Bridgeport, which is in charge of A. B. Pinkham, general manager. The company is manufacturing a line of accurate temperature controllers for vulcanizers, steam tables, pressers, etc., and a controller for working room temperatures for factories.

THE SUPERFOS CO. announces that Henry H. Stiller is now resuming his association with the company as sales manager, devoting his entire time to the promotion of the selling of its specialties in imported chemicals.

THE CHICAGO PNEUMATIC TOOL CO., has taken over the exclusive sale of all of the products of the Crescent Pump Co., and will in the future handle all inquiries regarding same.

Opportunities in the Foreign Trade

Parties interested in any of the following opportunities may obtain all available information from the Bureau of Foreign and Domestic Commerce at Washington or from any district office of the bureau. The number placed after the opportunity must be given for the purpose of identification.

BONE, water-cooker; and polished or unpolished bone. Stockholm, Sweden. Purchase.—8055.

CAMPHOR, in ounce blocks. Winnipeg, Canada. Purchase.—8058.

CHLORINE, liquid, for sterilizing water. Rosario, Argentina. Purchase.—8056.

LINSEED OIL. Copenhagen, Denmark. Agency.—8051.

PHOSPHORUS, 100 kilos. Warsaw, Poland. Agency.—8054.

ROSIN AND TURPENTINE. Copenhagen, Denmark. Agency.—8051.

ROSIN AND TURPENTINE. Hamburg, Germany. Purchase.—8057.

SULPHUR, raw and refined, 40 to 60 tons monthly. Warsaw, Poland. Agency.—8054.

TURPENTINE of best quality. Calcutta, India. Purchase.—8082.

OILS, vegetable. Copenhagen, Denmark. Agency.—8051.